Tennessee Technology Literacy Challenge Fund: Evaluation Report

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Executive Summary

Introduction

The Technology Literacy Challenge Fund (TLCF) is a U.S. Department of Education program that provides grants to state agencies who in turn distribute the funds to schools and/or districts through a process of competitive educational technology grants. In Tennessee, over 230 schools submitted applications for TLCF funding. Of those, 26 schools were awarded grants of $200,000 for the 2001-2002 academic year. The TLCF grant required the schools to develop a building-level pilot program that had a full-time technology coach and utilized at least 50% of the funds for professional development. The technology coach was to be a certified teacher selected by each pilot school. The overall purpose of TLCF grants is achievement of the following four goals:

1. All teachers will have the training and support they need to help students learn using computers and the information superhighway.
2. All teachers and students will have modern multimedia computers in their classrooms.
3. Every classroom will be connected to the information superhighway
4. Effective software and online learning resources will be an integral part of every school's curriculum.

The present TLCF evaluation was structured around the following research questions:

1. To what extent are the following TLCF program goals realized?
   - All teachers will have the training and support they need to help students learn using computers and the information superhighway.
   - All teachers and students will have modern multimedia computers in their classrooms.
   - Every classroom will be connected to the information superhighway.
   - Effective software and online learning resources will be an integral part of every school's curriculum.
2. To what degree has there been an increase in:
   - the *quality* with which teachers employ technology in everyday teaching and learning?
   - the *extent* with which teachers employ technology in everyday teaching and learning?
   - development of a "professional learning community" (of technology users)?
3. What are school outcomes in school climate, teaching practices, degree and type of technology use, and student achievement? To what extent do these variables correlate with one another and with implementation success?
4. What factors appear most instrumental in determining schools' success at achieving the four program goals and overall implementation of the program?

Method

Design

The evaluation design was based on both quantitative and qualitative data collected from classroom observations, teacher surveys and focus groups, technology coach surveys and interviews, principal interviews, and school-developed technology benchmarks. Participating schools were all 26 that received TLCF grants for 20001-2002.

Instrumentation

The 10 instruments listed below were used to collect the evaluation data:

Observation Measures

Observations were made focusing on (a) whole-school (random visits) and (b) targeted classes (scheduled visits) using three instruments.

- *School Observation Measure (SOM)*: Examines frequency of usage of 24 instructional strategies.
- *Survey of Computer Use (SCU)*: Examines availability and student use of technology and software applications.
- *Expanded Rubric*: Rates the degree of learner engagement in cooperative learning, project-based learning, higher-level questioning, experiential/hands-on learning, student independent inquiry/research, student discussion, and students as producers of knowledge using technology.

Surveys

- *Teacher Technology Questionnaire (TTQ)*: Collects teacher perceptions of computers and technology.
- *School Climate Inventory (SCI)*: Assesses school staff perceptions of school climate on seven dimensions: Order, Leadership, Environment, Involvement, Instruction, Expectations, and Collaboration.
- *Technology Coach Survey*: Describes coaches' involvement in TLCF and activities in relation to the four major goals of the program.

Interviews

- *Teacher Focus Group*: Asks teachers in small groups at each schools to describe their role in achieving the four TLCF goals and any positive or negative factors that influenced goal achievement.
- *Principal Interview*: Asks about principal experiences in working with the TLCF program, its specific goals, and program activities of school staff.
- *Technology Coach Interview*: Similar to the Technology Coach Survey, asks coaches to describe and react to their program experiences, particularly in relation to the four TLCF goals.

Technology Benchmarks

- *Implementation Benchmarking Tool*: Documents the primary operational components of the school's technology program for the areas of Curriculum, Instruction, and Organization.

Procedure

Data for this evaluation study were collected in two phases: Fall (September-October, 2001) and Spring (April-May, 2002). In the fall, two whole-school and two targeted observations were conducted by trained observers, teachers completed the Teacher Technology Questionnaire, and a technology benchmark document were drafted and ratings were completed. The SOM and SCU were completed for both the whole-school and targeted visits, while the Expanded Rubric was completed only for the targeted observations. Spring data collection included four whole-school and four targeted observations, teacher focus groups, principal interviews, coach interviews and surveys, teacher completion of the School Climate Inventory and Teacher Technology Questionnaire, and the second rating of technology benchmarks.

Results

School Observation Measure (SOM©)

The descriptive SOM results were revealing in showing usage of a variety of teaching strategies ranging from traditional (direct instruction and independent seatwork) to alternative (project-based learning, independent inquiry, technology as a learning tool). Statistical analyses yielded significant Fall-Spring differences on 9 of the 24 SOM strategies: All, except direct instruction and independent seatwork (both traditional practices), showed higher frequency of observation in the Spring. In contrast, the strategies showing Spring increases, such as work centers, project-based learning, systematic individual instruction, and independent inquiry, tended to be more student-centered. Technology use and student attention/interest also increased from Fall to Spring. Targeted observations yielded similar results.

Expanded Rubric (ER)

Results on the ER showed more frequent and meaningful use of strategies in the Spring than in the Fall targeted observations. Strategies significantly more likely to be observed in the Spring were project-based learning, independent inquiry, and students as producers of knowledge. Rubric means (from 1 to 4) fell generally in the 1.50 to 2.90 range, suggesting moderate levels of quality/effectiveness. The relatively high means achieved in the Spring for project-based learning ($M = 2.91$) and experiential learning ($M = 2.79$) reflect relatively high attainment compared to typical schools. Three strategies showed significantly higher ratings in the Spring than in the Fall: cooperative learning, independent inquiry, and student discussion ($ES = -0.63$). Thus, teachers apparently were using these strategies more meaningfully and intensively over time. Additional analysis revealed greater frequency of technology use in association with the ER strategies in the Spring. Overall, these results show noticeable

progression over the school year in (a) frequency and quality of use of the ER strategies, and (b) integration of technology with strategy use.

Survey of Computer Use (SCU©)

The SCU results from whole-school and targeted visits indicated progress in teachers' integration of technology at the TLCF schools. Specifically, in comparisons from the Fall to the Spring, there were significant increases in individual student use of computers, student computer skills, use of presentation software, use of the Internet, and, perhaps most importantly, meaningful use (integration) of technology with classroom instruction.

Teacher Technology Questionnaire

The results of the Teacher Technology Questionnaire demonstrate very strong teacher support for the TLCF goals, particularly with regard to technology integration with curriculum, lesson planning, and instructional delivery. Considering the very large and seemingly representative sample of respondents (Spring n = 1,133), the reactions are strikingly positive and indicative of high satisfaction with professional development, coaching support, student activities, and impacts on the quality of instruction. The inferential analyses yielded highly significant outcomes reflecting positive attitude changes from the Fall to Spring assessments.

School Climate Inventory (SCI)

SCI results showed generally positive attitudes about school climate by teachers across the 26 schools. All means exceed the middle (undecided) rating of 3.00. The two highest means were for Instruction (M = 4.04) and Leadership (M = 3.99). Overall, these results indicated that the TLCF schools were not debilitated by negative climate factors and had established generally facilitative environments for implementing reforms.

Technology Coach Survey

The order in which the goals were perceived by coaches as being fully obtained were Goal 3 (Internet connection; 85%), Goal 2 (modern multimedia computers; 77%), Goal 4 (effective software and online resources; 50%), and Goal 1 (all teachers have training and support; 42%). However, from 92-96% rated each goal attainment as either 4 (>Somewhat) or 5 (Fully) on the rating scale, thus indicating generally positive impressions of moderate to high implementation progress.

Coaches identified their most frequent roles as: set up and load software, order hardware/software, troubleshoot classroom or lab computers, design technology training sessions, assist teachers with computer skills, coach teachers to use technology, locate web-based technology integration materials, provide motivation for technology integration efforts, provide one-on-one tech training to teachers, and provide small group tech training. The least frequent activities were to set up/maintain networks, visit other schools, and provide whole school/large group training. There was strong consensus by coaches that extensive support was received from the administration. About three-fourths were positive about teachers' involvement in decision

making, and felt that they (coaches) had a sufficiently flexible schedule and adequate time to meet teachers' needs. Close to 70% mostly or extensively agreed that they were able to fulfill the defined responsibility of the technology coach.

Teacher Focus Groups

Teachers were extremely positive about the activities and accomplishments for Goals 1 (Training) and 3 (Internet). They also felt that substantial progress but not full attainment had been realized for Goals 2 (Multimedia computers) and 4 (Software/online integration).

Teachers strongly felt that they were using and integrating technology more than in the past. Concomitantly, quality of teaching and learning activity had been improved, as exemplified by more student-centered activities, greater involvement in coaching, improved student work, decreased drill-and-practice, increased emphasis on higher-level thinking, and more meaningful use of common applications such as Power Point. As a consequence of these activities, teachers believed that there was higher student achievement, increased computer literacy and fewer discipline problems. Impacts on school climate were seen as positive from the standpoint of increasing student ownership, faculty bonding, improved morale, and excitement by the school community including parents.

Challenges of the TCLF initiative were viewed as insufficient time, stress due to frustrations and change, and the demands of learning so many new skills. Suggested improvements were to involve the faculty and begin the training earlier in the year, extend the duration of the grant, and provide full-time technical support.

Principal Interviews

The principals believed that many teachers were impacted positively by the training, interest was high, student work had improved, and the coaches were effective (Goal 1). Negative factors were the removal of teachers from the classroom, some teacher resistance, and the time demands. Goal 2 (multimedia technology) was viewed as mostly realized through the workstations established in nearly all classrooms. Some classrooms, however, still had outdated computers. Principals believed that nearly all classrooms were connected to the Internet, thus achieving the main criterion for Goal 3. Concerns were expressed about equipment needs, technical difficulties, some teachers being inexperienced or unskilled, and students possibly having access to inappropriate content. Goal 4 (integration of technology) was viewed as mostly but not yet completely realized. The primary barriers were viewed as cost, additional teacher training needs, training time, and insufficient resources.

Principals believed that increases in technology use and integration were visible and substantial. A foundation for developing "professional learning communities" was established at many schools through enhanced communications and collaboration. School climate was also described in very positive terms.

Technology Coach Interview

According to coaches, their most prominent role was directly providing training and mentoring to teachers. Another major coach role was helping to their schools to acquire the multimedia technology needed. While coaches often needed to provide technical support, most sought outside assistance to free themselves for training and mentoring roles.

Coaches identified critical skills needed for success as computer expertise, communication skills, people skills, and knowledge of teaching/technology standards. Essential personal characteristics included patience, vision, motivation, and organization. In general, coaches conveyed a clear sense of accomplishment in achieving the four Goals of TCLF. Their major challenge was lack of time, particularly given the late start of the project. While coaches mentioned the typical problems of equipment breakdowns, some negative teacher attitudes, and lack of sufficient resources to achieve fully all Goals, the overall tone of their reaction was positive, reflecting strongly that benefits to the school, teachers, and students had resulted from the infusion and attempted integration of technology in classrooms.

Technology Benchmarks

Results strikingly showed substantial progress in implementing Technology Benchmarks for all Categories (Curriculum, Instruction, and Organization) during the year. For example, in the Spring, close to 70% of the Benchmarks were rated as being implemented at Phase III (full) status as opposed to close to none in the Fall. Comparisons of mean status ratings (from 1 to 3) further indicated much higher implementation status in the Spring ($M = 2.62$) than in the Fall ($M = 1.12$).

Conclusions

TLCF Program Goals

To what extent are the following TLCF program goals realized?

- *All teachers will have the training and support they need to help students learn using computers and the information superhighway.*

Results from multiple sources, including reports and ratings from teachers, coaches, and principals, suggested that considerable progress was made via the TLCF experiences in preparing teachers to integrate technology into curriculum and instruction. While the majority of coaches (58%) did not feel that Goal 1 was "fully" realized, nearly all (92%) rated goal attainment as either 4 or 5 on the five-point rating scale. Notably, on the Teacher Technology Questionnaire, statistically significant Fall-to-Spring increases (nearly all showing Effect Sizes of 0.50 or higher) in teacher ratings of their experiences and skill levels were found on all 20 items. Results on the Survey of Computer Use showed significant increases from Fall to Spring in uses of the Internet, use of presentation software, and most importantly, meaningful integration of technology with classroom instruction. Despite these impressive accomplishments, respondents noted the limited time to provide all needed training, the negative

attitudes or resistance by some teachers, and the lack of opportunity to apply the skills learned to lesson design and delivery.

- *All teachers and students will have modern multimedia computers in their classrooms.*

As indicated by the classroom observations and participant reactions, Goal 2 (acquisition of multimedia computers) was close to being realized at most schools. Specifically, the SCU observations showed statistically significant increases from Fall to Spring in the number of computers that were "up to date" and had Internet access. Still, there were some classrooms observed that did not have modern or sufficient technology, a situation confirmed by teachers, principals, and coaches. Close to 80% of the coaches felt that the Goal 2 had been fully achieved at their schools. In the Spring, 80% of the teachers believed that their students had adequate access to up-to-date technology resources, a noteworthy increase from the 46% agreement in the Fall.

- *Every classroom will be connected to the information superhighway.*

Multiple data sources suggest that Goal 3 (Internet) came the closest of all four goals of being fully achieved. On the basis of teacher focus group responses, 23 out of 26 schools had complete or nearly complete classroom connectivity. Principal and coaches gave the same impression in surveys or interviews. In many instances, the limiting factor had to do with wiring needs, inappropriate software, or some type of technical difficulty.

- *Effective software and online learning resources will be an integral part of every school's curriculum.*

As revealed by the observations (SOM, SCU, and Expanded Rubric), progress on Goal 4 (integration of resources) was substantial during this first year, but acquiring the resources and training for full goal attainment will take much more time. While coaches were positive about what was accomplished, they admitted that barriers were their personal lack of time, equipment problems, some negative teacher attitudes, and the late start of the integration training. Several principals rated Goal 4 as mostly achieved, but mirrored the coaches' impressions about the challenges of bringing all teachers on board and finding sufficient time for training. Teachers strongly conveyed that, despite increased skills and confidence, they still lacked the skills needed to make technology a true integral part of instruction and learning.

Technology Integration

To what degree has there been an increase in:

- *the quality with which teachers employ technology in everyday teaching and learning?*

In targeted SCU observations, "meaningful" use of computers was seen frequently or extensively in 40% of the Spring sessions but in only 23% of the Fall sessions. On the Extended Rubric assessments, observers described many uses of technology in association with student-centered and higher-order teaching strategies. Coaches, teachers, and principals cited examples

of effective technology use and gave positive overall impressions of progress. However, continued training and support will be needed to maintain and expand their skills while preparing new teachers to keep pace.

- *the extent with which teachers employ technology in everyday teaching and learning?*

Results from the SOM indicated occasional or more usage of computers as a learning tool in close to one-third of the Spring visits (Fall = only 6%). Similarly, computers were observed being used for instructional delivery occasionally or more in close to 40% of the Spring visits (Fall = 10%). For five of the seven Expanded Rubric strategies (cooperative learning, project-based learning, higher-level questioning, experiential learning, and independent inquiry), there were significant Fall-to-Spring increases in the percentage of times that technology use was observed during targeted sessions. While there is substantial room for growth and not all teachers are bought in at each school, the extent of technology usage in TLCF schools compared to typical U.S. schools was much greater during the year and especially so by the spring.

- *development of a "professional learning community" (of technology users)?*

Teachers, coaches, and principals all described the school community as highly supportive of the technology integration interventions. Still, we believe that well-grounded "communities of practice" were not yet established at the majority of schools. Foundations for such communities were initiated, primarily through the coaching model and peer-support structure promoted by TLCF. These formal support systems will probably need to continue in subsequent years (with or without funding) for full communities of practice to become developed and sustained.

School Climate, Teaching Practices, Technology Use

What are school outcomes in school climate, teaching practices, degree and type of technology use, and student achievement. To what extent do these variables correlate with one another and with implementation success?

At the time of this writing (July, 2002), the researchers have not received school-level achievement data for the 2002 school year. While analyses of student achievement may have limited meaning due to confounding variables and the limited time for program implementation, they can be performed at a later time to determine descriptive outcomes and any noteworthy patterns.

Influencing Factors

What factors appear most instrumental in determining schools' success at achieving the four program goals and overall implementation of the program?

Based on the multiple data sources, we believe the following factors to have been the most influential in achieving program goals and successful implementation:

- Strong preparation and dedication of the coaches
- Effective organization of the TLCF project by the TDOE in terms of expectations, timelines, and especially, accountability
- Strong principal support at most schools
- The coaching model in general as a means of motivating and assisting teachers
- Substantive acquisition of up-to-date computer hardware and software
- Focus on classroom integration as opposed to technical aspects of technology
- Solid teacher support for the interventions
- Positive school climate (cooperation, involvement, environment, leadership, instruction) at most schools

Overall, we strongly feel that the TLCF program realized impressive progress in achieving its goals. Despite these accomplishments, there is only so much that can be done in a given year to create strong structures and communities of practice needed to ensure sustainability. Ultimately, for a program to be successful and sustaining, schools themselves must take ownership over implementing them. The one-year duration of the TLCF places schools on a much faster timetable for autonomy than is optimal. Still, if adequate ownership and interest exist at the school level, it should certainly be possible in future years for motivated teachers, coaches, and principals to maintain and improve the technology integration started under TLCF and documented in this report.

Tennessee Technology Literacy Challenge Fund: Evaluation Report

This report summarizes the results of the Tennessee Technology Literacy Challenge Fund (TLCF) evaluation study. The overall purpose of the evaluation was twofold: (a) to provide formative evaluation data to the pilot schools to provide a basis for improvement planning and to document their accomplishments for local usage; and (b) to provide cumulative evidence of the implementation progress and outcomes of the pilot schools.

Tennessee Technology Literacy Challenge Fund

The Technology Literacy Challenge Fund (TLCF) is a U.S. Department of Education program that provides grants to state agencies who in turn distribute the funds to schools and/or districts through a process of competitive educational technology grants. The overall purpose of TLCF grants is achievement of the following four goals:

1. All teachers will have the training and support they need to help students learn using computers and the information superhighway.
2. All teachers and students will have modern multimedia computers in their classrooms.
3. Every classroom will be connected to the information superhighway
4. Effective software and online learning resources will be an integral part of every school's curriculum.

In Tennessee, over 300 schools submitted applications for TLCF funding. Of those, 26 schools were awarded grants of $200,000 for the 2001-2002 academic year. The TLCF grant required the schools to develop a building-level pilot program that had a full-time technology coach and utilized at least 50% of the funds for professional development. The technology coach was to be a certified teacher selected by each pilot school. The roles and responsibilities of the technology coach were as follows:

- Is responsible for developing and sustaining professional development for the faculty in order that over the course of the pilot they may grow in their mastery of infusion techniques
- Is responsible for the required publications
- May visit other schools to observe best practice
- May engage outside exemplary teachers to hold clinic workshops for teachers
- May model lessons for the pilot faculty
- May not be the de facto tech support person (Tennessee TLCF RFP, pg.6)

The professional development was to be targeted toward preparing teachers to routinely infuse the use of computers as tools into classroom instruction. The overall goal of the technology infusion was improvement in student achievement in areas identified by the state for accountability measures: language arts, math, reading, science and social studies. As an

incentive for raising student achievement, TLCF schools were eligible for bonus awards of $50,000 to $100,000 if pre-determined individualized performance goals were met.

Research Questions

The TLCF evaluation was structured around four primary research questions that focused on the achievement of the four program goals, classroom practices, degree and type of technology use, academically focused time, student engagement, and school climate. Also of interest was the reaction and support of technology coaches, teachers and administrators. Originally, it was planned to examine "best practices," but given time constraints and other priorities, it was decided not to include this area in the present study. The detailed questions are listed below:

1. To what extent are the following TLCF program goals realized?
   - All teachers will have the training and support they need to help students learn using computers and the information superhighway.
   - All teachers and students will have modern multimedia computers in their classrooms.
   - Every classroom will be connected to the information superhighway.
   - Effective software and online learning resources will be an integral part of every school's curriculum.
2. To what degree has there been an increase in:
   - the *quality* with which teachers employ technology in everyday teaching and learning?
   - the *extent* with which teachers employ technology in everyday teaching and learning?
   - development of a "professional learning community" (of technology users)?
3. What are school outcomes in school climate, teaching practices, degree and type of technology use, and student achievement? To what extent do these variables correlate with one another and with implementation success?
4. What factors appear most instrumental in determining schools' success at achieving the four program goals and overall implementation of the program?

Evaluation Design and Measures

The evaluation period extended from September 1, 2001 through June 30, 2002. The evaluation design was based on both quantitative and qualitative data collected from classroom observations, teacher surveys and focus groups, technology coach surveys and interviews, principal interviews, school-developed technology benchmarks, and school-submitted best practices technology lessons. Pre- (before October 2001) and post- (after April 1, 2002) data were collected for comparative analyses of classroom observations, the Teacher Technology Questionnaires, and the school benchmark ratings. Descriptive analyses were completed for teacher, technology coach, and administrator reactions to the TLCF program. At the time of this writing (June, 2002), we do not have access to the schools' achievement results on the TCAP for 2002. Nor do we have the "best practices" data. These results, if provided, can be incorporated in an addendum to this report. All schools will be mailed individual reports in late July or early August, 2002, thus satisfying the formative evaluation goal of this study.

Participants

All 26 schools that were awarded TLCF grants for the 2001-2002 academic year participated in the evaluation. Collectively, the schools had close to 19,000 students and 1,400 teachers. Specific distribution of schools by grade level, number of teachers and number of students is shown below:

Schools by Grade Level	Total Schools	Total Students	Total Teachers
Elementary (K-5)	13	7,326	564
Middle (6-8)	6	4,652	298
Elementary-Middle (K-8)	2	1,638	149
High School (9-12)	5	5,353	358
Overall	26	18,969	1,369

Instrumentation

Ten instruments were used to collect the evaluation data: three classroom observation measures, two teacher and one technology coach survey, three focus group/interviews, and the technology benchmark tool. Detailed descriptions of each instrument follows.

Classroom Observation Measures

Whole-school and targeted classroom visits were conducted by trained and unbiased observers to collect frequency data regarding observed instructional practices. The data collection instruments were the School Observation Measure (SOM), the Survey of Computer Use (SCU), and the Expanded Rubric (ER). The SOM was used to collect data regarding overall classroom activities, the SCU for student use of computers, and the ER for capturing more detailed information about student-centered activities during the targeted observations.

School Observation Measure (SOM). The SOM was developed to determine the extent to which different common and alternative teaching practices are used throughout an entire school (Ross, Smith, & Alberg, 1999). The standard, or *whole-school SOM*© procedure involves observers' visiting 10-12 randomly selected classrooms, for 15 minutes each, during a three-hour visitation period. The observer examines classroom events and activities descriptively, not judgmentally. Notes are taken relative to the use or nonuse of 24 target strategies. At the conclusion of the three-hour visit, the observer summarizes the frequency with which each of the strategies was observed across all classes in general on a data summary form. The frequency is recorded via a 5-point rubric that ranges from (0) Not Observed to (4) Extensively. Two global items use three-point scales (low, moderate, high) to rate, respectively, the use of academically-focused instructional time and degree of student attention and interest. *Targeted* observations were conducted to examine classroom instruction during prearranged one-hour sessions in which randomly selected teachers demonstrated a prepared lesson using technology. The notes forms were completed every 15 minutes of the lesson then were summarized on a Data Summary Form.

To ensure the reliability of data, observers receive a manual providing definitions of terms, examples and explanations of the target strategies, and a description of procedures for completing the instrument. The target strategies include traditional practices (e.g., direct instruction and independent seatwork) and alternative, predominately student-centered methods associated with educational reforms (e.g., cooperative learning, project-based learning, inquiry, discussion, using technology as a learning tool). The strategies were identified through surveys and discussions involving policy makers, researchers, administrators, and teachers, as those most useful in providing indicators of schools' instructional philosophies and implementations of commonly used reform designs (Ross, Smith, Alberg, & Lowther, 2001).

After receiving the manual and instruction in a group session, each observer participates in sufficient practice exercises to ensure that his/her data are comparable with those of experienced observers. In a reliability study (Lewis, Ross, & Alberg, 1999), pairs of trained observers selected the identical overall response on the five-category rubric on 67% of the items and were within one category on 95% of the items. Further results establishing the reliability and validity of *SOM*© are provided in the Lewis et al. (1999) report.

Survey of Computer Use (SCU). A companion instrument to SOM is the Survey of Computer Use (SCU) (Lowther & Ross, 2001). The SCU was completed as part of the SOM observation sessions, where SCU data was also recorded in 15-minute intervals and then summarized on an overall data form.

The SCU was designed to capture exclusively *student* access to, ability with, and use of computers rather than teacher use of technology. Therefore, four primary types of data are recorded: (a) computer capacity and currency, (b) configuration, (c) student computer ability and (b) student activities while using computers. Computer capacity and currency is defined as the age and type of computers available for student use and whether or not Internet access is available. Configuration refers to the number of students working at each computer (e.g., alone, in pairs, in small groups). Student computer ability is assessed by recording the number of students who are computer literate (e.g., easily used software features/menus, saved or printed documents) and the number of students who easily use the keyboard to enter text or numerical information.

The next section of the *SCU* focuses on student use of computers with regard to: the types of activities, subject areas of activities, and software being used. The computer activities are divided into three categories based on the type of software tool: production tools, Internet/research tools, and educational software. Within each category, primary types of software are identified. For example, under Production Tools, the software includes: word processing, databases, spreadsheets, draw/paint/graphics, presentation (e.g., PowerPoint™), authoring (e.g., HyperStudio™), concept mapping (e.g., Inspiration), and planning (MS Project™). For the Internet/research tools, three types of software are included: Internet browser, CD reference materials, and communications (e.g., email, listservs, chat rooms). The Educational Software also has three types of software: drill/practice/tutorial, problem-solving (e.g., Oregon Trail™) and process tools (e.g., Author's Toolkit™). With this type of recording system, several activities can be noted during the observation of one student working on a computer. For example, if a student gathered data from the Internet, created a graph from the

data, then imported the graph into a PowerPoint presentation, the observer would record three types of software tools as being observed: Internet browser, spreadsheet, and presentation. This section ends by identifying the subject area of each computer activity. The categories include: language arts, mathematics, science, social studies, and other. The computer activities and software being used are summarized and recorded using a five-point rubric that ranges from (0) Not Observed to (4) Extensively observed.

The final section of the SCU is an "Overall Rubric" designed to assess the degree to which the activity reflects "meaningful use" of computers *as a tool* to enhance learning. The rubric has four levels: 4 – Very meaningful, 3 – Meaningful, 2 – Somewhat meaningful, 1 – Low-level use of computers.

Expanded Rubric. The Expanded Rubric was developed by CREP (Lowther, Ross, & Plants, 2000) as an extension to SOM and SCU. The ER was used by observers to more closely evaluate the degree of learner engagement in seven selected areas considered fundamental to the goals of increasing student-centered learning activities (cooperative learning, project-based learning, higher-level questioning, experiential/hands-on learning, student independent inquiry/research, student discussion, and students as producers of knowledge using technology). These strategies reflect emphasis on higher-order learning and attainment of deep understanding of content and whether or not technology was utilized as a component of the strategy. Such learning outcomes seem consistent with those likely to be engendered by well-designed, real-world linked exercises, projects, or problems utilizing technology as a learning tool. Each item includes a two-part rating scale. The first is a five-point scale, with 1 indicating a very low level of application, and 5 representing a high level of application. The second is a Yes/No option to the question: "Was technology used?" with space provided to write a brief description of the technology use. The Expanded Rubric was completed as part of "targeted" observation periods (i.e., scheduled technology usage).

Surveys

Three surveys were used to collect impressions of TLCF: the Teacher Technology Questionnaire (TTQ), the School Climate Inventory (SCI), and the Technology Coach Survey. Each is described below.

Teacher Technology Questionnaire (TTQ). The Teacher Technology Questionnaire is a three-part instrument used to collect teacher perceptions of computers and technology. In the first section teachers rate their level of agreement with 20 statements regarding five technology-related areas: impact on classroom instruction, impact on students, teacher readiness to integrate technology, overall support for technology in the school, and technical support. Items are rated on a five-point Likert-type scale that ranges from (1) Strongly Disagree to (5) Strongly Agree. Three primary questions are asked in the second section. The first asks teachers to rate their level of computer ability as very good, good, moderate, poor, or no ability. Next, teachers are asked if they have a home computer, and if they do, whether or not the home computer is used to access instructional materials on the Internet and/or to prepare instructional materials. The third item asks teachers to indicate how many classroom computers are available in their room for

student use. The final section of the TTQ contains general questions regarding years of teaching experience, age, gender, grade level, and current position.

School Climate Inventory (SCI). Researchers at the Center developed the School Climate Inventory (SCI) for Research in Educational Policy in 1989 (Butler & Alberg, 1991). The main purpose of the instrument is to assess impacts of reform initiatives in relation to seven dimensions logically and empirically linked with factors associated with effective school organizational climates. The inventory contains 49 items, with 7 items comprising each scale. Responses are scored through the use of Likert-type ratings ranging from strong disagreement (1) to strong agreement (5). Each scale yields scores ranging from 7 to 35, with higher scores being more positive. Additional items solicit basic demographic information on respondents.

Face validity of the school climate items and logical ordering of the items by scales were established during the development of the inventory (Butler & Alberg, 1991). Subsequent analysis of responses collected through administration of the inventory in a variety of school sites substantiated validity of the items. Scale descriptions and current internal reliability coefficients on the seven scales of the inventory, obtained using Cronbach's alpha are as follows:

Scale	Internal Reliability	Description
Order	α=.8394	The extent to which the environment is ordered and appropriate student behaviors are present
Leadership	α=.8345	The extent to which the administration provides instructional leadership
Environment	α=.8094	The extent to which positive learning environments exist
Involvement	α=.7582	The extent to which parents and the community are involved in the school
Instruction	α=.7453	The extent to which the instructional program is well developed and implemented
Expectations	α=.7275	The extent to which students are expected to learn and be responsible
Collaboration	α=.7417	The extent to which the administration, faculty, and students cooperate and participate in problem solving

Technology Coach Survey. The Technology Coach Survey was created specifically for the present study. The survey is divided into three sections. The first section is used to collect demographic information about participants (gender, age, teaching experience) and their schools (setting, number of teachers, grade levels, and number of students), and how and why the respondents were selected as technology coach. The second section asks questions related to the four educational technology goals of Goals 2000. Specifically, respondents are asked to (a) rate the degree to which the school has achieved each goal, (b) rate the degree to which they were involved with the achievement of the goal, and (c) list key supporting factors and barriers to achieving the different goals. In the third section, the coaches are presented with 23 tasks for which a technology coach may be responsible. They are asked to indicate how frequently they were involved in each task and to rate the degree to which they thought the task supported technology integration efforts at their school. Six additional items ask them to indicate the

frequency with which the listed items occurred. The focus of the six items are: 1) administration support of coaching efforts; 2) administration support of overall technology program; 3) effect of school size on ability to fulfill "coaching" responsibilities; 4) teacher ownership of technology program; 5) ability of coach to follow-up with teachers after professional development; and 6) frequency of which training specifically met the needs of teachers in different grade levels or subject areas. The last item on the survey asks coaches to indicate how frequently they were able to fulfill their responsibilities as it relates to the RFP definition of the role of a technology coach:

"The Technology Coach is there in a supportive, coaching and training mode, and therefore cannot and should not be used in the capacity of Technology Support" (TLCF RFP, 2001, p.4).

Focus Groups/Interview Measures

CREP developed instruments for the teacher focus group, the technology coach interview, and the principal interview. Items for each instrument were structured to address the research questions for this evaluation study.

Teacher Focus Group. The Teacher Focus Group questions were targeted toward five major areas. Teachers were first asked to describe their role in achieving the four TLCF goals and any positive or negative factors that influenced goal achievement. The next set of questions focused on the degree to which TLCF had impacted the frequency and quality with which technology was integrated into everyday teaching and learning, the development of a professional learning community of technology users, teaching practices, technology use by teachers, technology use by students, and student achievement. These questions were followed by a question that asked teachers to describe the key features of a best practice in technology use. The final questions solicited teacher perceptions of the greatest benefits and challenges of participating in the TLCF Initiative and suggested improvements for other schools that might implement a TLCF Initiative. Trained researchers conducted one focus group, comprised of six to eight randomly selected teachers, at each of the 26 schools.

Principal Interview. The Principal Interview questions were the same as those used for the Teacher Focus Group. The 26 principals were individually interviewed by trained researchers in on-site sessions that lasted approximately one hour.

Technology Coach Interview. The same researchers who completed the teacher focus groups and principal interviews conducted the technology coach interviews in on-site sessions that lasted approximately one hour. As with the others, the interview questions began by asking the coaches to describe what they did to ensure that the four TLCF Goals were achieved and to discuss any positive or negative factors that may have impacted goal achievement. The next portion of the interview asked the coaches to describe how they approached the following eight key responsibilities that were outlined in the TLCF Request for Proposals:

- Describe your involvement, if any, with *designing technology training* sessions.
- What types of *technology training did you personally deliver*?
- How did you *research and assist teachers with their technology needs*?
- Describe some ways that *you provided motivation towards the goal of infusing technology* into your school.
- Provide some examples of how *you modeled technology integration*.
- What approaches did you use to *coach teachers on using technology in their classrooms*?
- Describe any *visits that you made to other schools to observe best practices*.
- Did the professional development at your school include *inviting exemplary teachers to provide workshops* for teachers? If yes, please describe how this approach worked.

The coaches were then asked to describe why or why not the following statement from the TLCF Request for Proposals was reflective of their role during the past year:

"*The Technology Coach is there in a supportive, coaching, training mode, and therefore cannot and should not be used in the capacity of Technology support."*

The interview ended with seven general questions. The first three focused on the key skills, expertise, and personal characteristics needed to be a successful technology coach. The next two asked what primary factors would enhance or inhibit a school's ability to have a successful technology coach program. The coaches were then asked to describe the most rewarding and challenging aspects of being a coach and what could be done to increase the effectiveness of technology coaches. The last question asked for any additional comments.

Technology Benchmarks

Implementation Benchmarking Tool. The Implementation Benchmarking Tool was developed by the Center for Research in Educational Policy (CREP). In CREP's work in over 400 schools in multiple states, it was found that a highly critical component of formative evaluation and improvement planning in Comprehensive School Reform is the development of individualized "Implementation Benchmarks." The benchmark development process accomplishes the following:

1. Documents the primary operational components of a whole-school program to increase understanding of both the overall program and individual school goals relative to implementation rate and scope.
2. Engages the entire school staff in discovering, developing, reflecting on, and refining the school's programs. For example, computer usage can be more effectively integrated with various subjects and state and local standards.
3. Provides a framework for evaluating progress from beginning to full implementation.
4. Provides a tool for communicating implementation status and progress.

A specific Indicator and Evidence accompany each Benchmark Statement for implementation Phases I (Beginning), II (Intermediate), and III (Full). The draft benchmarks are then shared with the entire faculty for review. Typical timelines are to complete the

implementation benchmarks by mid-October, refine them if needed during the year, and then, by early May, engage the entire faculty in evaluating progress and specifying program goals for the following year. Based on those goals, the Benchmarks are continually revised and refined. Consequently, participating schools are continually aware of all programs, implementation progress, and directions for school improvement directed by data and shared faculty-administrator decision-making.

In August 2001, teams from each school were trained in benchmark development then asked to develop technology benchmarks for the areas of Curriculum, Instruction, and Organization. After the benchmarks were developed, the schools indicated the Phase for each individual benchmark as of September 1, 2001 and then again as of May 1, 2002.

Procedure

Data for this evaluation study were collected in two phases: Fall (September-October, 2001) and spring (April-May, 2002). In the fall, two whole-school and two targeted observations were conducted by trained observers, teachers completed the Teacher Technology Questionnaire, and Technology Benchmarks were drafted and ratings were completed. The SOM and SCU were completed for both the whole-school and targeted visits, while the Expanded Rubric was completed only for the targeted observations. The whole-school visits were specifically scheduled to occur on varied days and times for each school. For the targeted visits, teachers from each school were randomly selected and informed prior to the observation to demonstrate a prepared lesson using technology. Observers worked with the technology coaches to schedule all data collection events. Spring data collection included four whole-school and four targeted observations, teacher focus groups, principal interviews, coach interviews and surveys, teacher completion of the School Climate Inventory and Teacher Technology Questionnaire, and the second rating of technology benchmarks.

Faculty meetings were held at each of the 26 schools prior to any data collection to provide teachers with a brief overview of the study and a description of the data collection procedures. The teachers were ensured that (a) there would be no interest in evaluating individuals, (b) only group data would be examined and reported, and (c) to “be themselves” and teach the intended lesson in the usual way.

Data Collection

The following table provides the type of measures, instrument names, administration timeline, and a brief data collection description for each of the instruments.

Type of Measure	Instrument	Timeline	Description
Classroom Observations	SOM SCU	Fall 2001	• 52 three-hour *whole-school** observations (2 per school x 26 schools) • 52 one-hour *targeted*** observations (2 per school x 26 schools)
		Spring 2002	• 104 three-hour *whole-school** observations (4 per school x 26 schools) • 104 one-hour *targeted*** observations (4 per school x 26 schools)
	Expanded Rubric	Fall 2001	• 52 (2 per school x 26 schools)
		Spring 2002	• 104 (4 per school x 26 schools)
Surveys	Teacher Technology Questionnaire	Fall 2001	• 1,135
		Spring 2001	• 1,133
	School Climate Inventory	Spring 2002	• 1,153
	Technology Coach Survey	Spring 2002	• 26 (1 coach per school)
Focus Groups Interviews	Teacher Focus Group	Spring 2002	• 26 (1 focus group per school)
	Principal Interview	Spring 2002	• 26 (1 principal per school)
	Technology Coach Interview	Spring 2002	• 26 (1 coach per school)
Benchmarks	Implementation Benchmarking Tool	Fall 2001	• 26 (1 Benchmark document per school)
		Spring 2002	• 26 (1 Benchmark document per school)

Whole-school SOM and SCU visits were three-hour sessions in which about 10 randomly selected classes were observed for 15 minutes each. The purpose was to obtain a whole-school perspective on common teaching practices and technology use.

****Targeted*** observations used the SOM, SCU, and Expanded Rubric to examine classroom instruction during prearranged one-hour sessions in which randomly selected teachers demonstrated a prepared lesson using technology.

Results

The results of the study are presented below by instrument. In the *Discussion* section, findings are synthesized across instruments to address each research question. Regardless of design employed, we computed Effect Sizes (*ES*) using Cohen's *d* formula (Cohen, 1988) to determine the educational importance of differences. An *ES* indicates the number of standard deviations by which the "treatment" group surpasses the "control" group. According to Cohen, an *ES* having an absolute value greater than .25 is considered to be educationally important.

School Observation Measure (SOM©)

Observed vs. not observed. As indicated in the description of SOM, the observation procedure primarily focuses on 24 instructional strategies using a five-point rubric (0 = not observed, 1 = rarely, 2 = occasionally, 3 = frequently, and 4 = extensively). In an initial analysis, we computed the percentage of times a strategy was *not* observed (rubric category = 0) vs. observed (categories 1-4 combined) for whole-school (Table 1) and targeted observations (Table 2) conducted in Fall 2001 (baseline) and Spring 2002. As shown in Table 1, the strategies not observed in 80% or more of Fall whole-school classroom visits were parent/community involvement (90%), systematic individual instruction (94%), performance assessment (96%), and student self-assessment (92%). For the Spring whole-school classrooms, the listing was identical. More precise data regarding observed strategies will be presented below in association with the full rubric breakdowns.

Table 1

School Observation Measure Descriptive Summary:
Percentage of time an event was observed (1-4) versus not observed (0)
Whole-School Fall vs. Whole-School Spring

Strategies	Fall (n=52)		Spring (n=103)	
	Observed	Not Observed	Observed	Not Observed
Direct instruction	100.0	0.0	96.1	3.9
Team teaching	32.7	67.3	30.1	69.9
Cooperative/collaborative learning	65.4	34.6	63.1	36.9
Individual tutoring	25.0	75.0	33.0	67.0
Ability groups	28.8	71.2	35.3	64.7
Multi-age grouping	24.0	76.0	24.5	75.5
Work centers	48.1	51.9	54.9	45.1
Higher level instructional feedback	59.6	40.4	46.5	53.5
Integration of subject areas	30.8	69.2	28.7	71.3
Project-based learning**	25.0	75.0	46.1	53.9
Use of higher-level questioning	76.9	23.1	79.2	20.8
Teacher as a coach/facilitator	90.4	9.6	86.4	13.6
Parent/community involvement	9.6	90.4	12.6	87.4
Independent seatwork	100.0	0.0	99.0	1.0
Experiential, hands on learning	69.2	30.8	60.8	39.2
Systematic individual instruction	5.8	94.2	15.7	84.3
Sustained writing/composition	29.4	70.6	32.3	67.7
Sustained reading	50.0	50.0	63.1	36.9
Independent inquiry/research*	25.0	75.0	45.1	54.9
Student discussion	44.2	55.8	49.5	50.5
Computer for instructional delivery***	42.3	57.7	74.8	25.2
Technology as a learning tool***	50.0	50.0	76.7	23.3
Performance assessment	3.8	96.2	9.7	90.3
Student self-assessment	7.7	92.3	6.9	93.1

**p<.05, **p<.01, ***p<.001*

Table 2

School Observation Measure Descriptive Summary:
Percentage of time an event was observed (1-4) versus not observed (0)
Targeted Fall vs. Targeted Spring

Strategies	Fall (n=52)		Spring (n=104)	
	Observed	Not Observed	Observed	Not Observed
Direct instruction*	84.6	15.4	69.2	30.8
Team teaching	19.2	80.8	13.5	86.5
Cooperative/collaborative learning	36.5	63.5	51.9	48.1
Individual tutoring	13.5	86.5	13.5	86.5
Ability groups	7.7	92.3	15.4	84.6
Multi-age grouping	7.7	92.3	17.3	82.7
Work centers	30.8	69.2	31.7	68.3
Higher level instructional feedback	47.1	52.9	36.5	63.5
Integration of subject areas	26.9	73.1	23.1	76.9
Project-based learning***	15.4	84.6	41.3	58.7
Use of higher-level questioning	34.6	65.4	42.7	57.3
Teacher as a coach/facilitator	78.8	21.2	88.2	11.8
Parent/community involvement	5.8	94.2	3.8	96.2
Independent seatwork	65.4	34.6	52.9	47.1
Experiential, hands on learning	44.2	55.8	36.5	63.5
Systematic individual instruction	0.0	100.0	5.8	94.2
Sustained writing/composition	17.3	82.7	16.3	83.7
Sustained reading	23.1	76.9	12.5	87.5
Independent inquiry/research**	19.2	80.8	43.3	56.7
Student discussion	19.2	80.8	28.8	71.2
Computer for instructional delivery	51.9	48.1	55.8	44.2
Technology as a learning tool**	67.3	32.7	85.6	14.4
Performance assessment	5.8	94.2	4.8	95.2
Student self-assessment	7.7	92.3	1.9	98.1

**p<.05, **p<.01, ***p<.001*

For the present two-category breakdown of observed vs. not observed, we conducted 2 (Time Period) by 2 (Rating Category) chi-square analyses on each item. Significant relationships were obtained on four of them (see asterisks on Tables 1) for the whole-school observations. On all four, the strategy was observed more frequently in the Spring than in the Fall: Project-based learning (46% vs. 25%), independent inquiry/research (45% vs. 25%), computer for instructional delivery (75% vs. 42%), and computer as a learning tool (77% vs. 50%).

Table 2 shows similar results for the targeted observations, although the latter yielded a larger list of strategies that were not observed during 80% or more of the visits. Specifically, the Fall listing included team teaching, individual tutoring, ability grouping, multi-age grouping, project-based learning, parent/community involvement, systematic individual instruction, sustained writing, independent inquiry/research, student discussion, performance assessment, and student self-assessment. Direct instruction, in contrast, was observed in 85% of the Fall visits. The chi-square tests showed significant relationships between Time Period and Rating Category on three of the four items that were significant in the whole-school analyses: project-based learning, independent inquiry, and technology as a learning tool. While these showed an increase over time, a fourth significant item—direct instruction, showed a decrease. These results, overall, reflect a tendency for instruction to have become more student-centered and technology-supported from Fall to Spring.

Full rubric. Tables 3 and 4 present the full, five-category breakdown for the whole-school and targeted Fall, Spring, and Combined observations, respectively. For whole-school classrooms (Table 3), strategies viewed frequently or extensively in at least 30% of the classrooms in the Combined analysis (third column for each rating) include direct instruction (65%) and independent seatwork (63%). For targeted classrooms, the list extends to include cooperative learning (33%), teacher as coach/facilitator (62%), and technology as a learning tool (69%). Inspection of the frequencies on Tables 3 and 4 will also reveal greater use of student-centered strategies, such as project-based learning, cooperative learning, and student inquiry, in the Spring than in the Fall.

Table 3

Whole-School SOM Descriptive Summary: Complete Rubric

SOM Aggregate Data[a]															
The extent to which each of the following was used or present in the school...	**Percent None**			**Percent Rarely**			**Percent Occasionally**			**Percent Frequently**			**Percent Extensively**		
	Fall	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**
Instructional Orientation															
Direct instruction (lecture)	0.0	3.9	2.6	1.9	10.7	7.7	21.2	26.2	24.5	44.2	46.6	45.8	32.7	12.6	19.4
Team teaching	67.3	69.9	69.0	30.8	21.4	24.5	1.9	8.7	6.5	0.0	0.0	0.0	0.0	0.0	0.0
Cooperative/collaborative learning	34.6	36.9	36.1	48.1	47.6	47.7	17.3	15.5	16.1	0.0	0.0	0.0	0.0	0.0	0.0
Individual tutoring (teacher, peer, aide, adult volunteer)	75.0	67.0	69.7	19.2	28.2	25.2	5.8	4.9	5.2	0.0	0.0	0.0	0.0	0.0	0.0
Classroom Organization															
Ability groups	71.2	64.1	66.5	15.4	27.2	23.2	9.6	3.9	5.8	0.0	0.0	0.0	3.8	3.9	3.9
Multi-age grouping	73.1	74.8	74.2	3.8	9.7	7.7	5.8	4.9	5.2	3.8	3.9	3.9	9.6	5.8	7.1
Work centers (for individuals or groups)	51.9	44.7	47.1	34.6	22.3	26.5	9.6	18.4	15.5	3.8	13.6	10.3	0.0	0.0	0.0
Instructional Strategies															
Higher level instructional feedback (written or verbal) to enhance student learning	40.4	52.4	48.4	30.8	31.1	31.0	26.9	12.6	17.4	1.9	1.9	1.9	0.0	0.0	0.0
Integration of subject areas (interdisciplinary/thematic units)	69.2	69.9	69.7	26.9	24.3	25.2	1.9	3.9	3.2	1.9	0.0	0.6	0.0	0.0	0.0
Project-based learning	75.0	53.4	60.6	23.1	31.1	28.4	1.9	10.7	7.7	0.0	3.9	2.6	0.0	0.0	0.0
Use of higher-level questioning strategies	23.1	20.4	21.3	34.6	35.0	34.8	34.6	29.1	31.0	7.7	13.6	11.6	0.0	0.0	0.0
Teacher acting as a coach/facilitator	9.6	13.6	12.3	34.6	28.2	30.3	34.6	29.1	31.0	17.3	21.4	20.0	3.8	7.8	6.5
Parent/community involvement in learning activities	90.4	87.4	88.4	9.6	11.7	11.0	0.0	1.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Student Activities															
Independent seatwork (self-paced worksheets, individual assignments)	0.0	1.0	0.6	5.8	14.6	11.6	19.2	27.2	24.5	53.8	49.5	51.0	21.2	7.8	12.3
Experiential, hands-on learning	30.8	38.8	36.1	57.7	37.9	44.5	9.6	16.5	14.2	1.9	5.8	4.5	0.0	0.0	0.0
Systematic individual instruction (differential assignments geared to individual needs)	94.2	83.5	87.1	5.8	10.7	9.0	0.0	2.9	1.9	0.0	1.9	1.3	0.0	0.0	0.0
Sustained writing/composition (self-selected or teacher-generated topics)	69.2	65.0	66.5	25.0	21.4	22.6	3.8	8.7	7.1	0.0	1.0	0.6	0.0	0.0	0.0
Sustained reading	50.0	36.9	41.3	30.8	33.0	32.3	11.5	22.3	18.7	5.8	7.8	7.1	1.9	0.0	0.6
Independent inquiry/research on the part of students	75.0	54.4	61.3	25.0	33.0	30.3	0.0	8.7	5.8	0.0	2.9	1.9	0.0	0.0	0.0
Student discussion	55.8	50.5	52.3	34.6	29.1	31.0	9.6	17.5	14.8	0.0	2.9	1.9	0.0	0.0	0.0

Table 3

Whole-School SOM Descriptive Summary: Complete Rubric, continued

SOM Aggregate Data[a]															
The extent to which each of the following was used or present in the school...	**Percent None**			**Percent Rarely**			**Percent Occasionally**			**Percent Frequently**			**Percent Extensively**		
	Fall	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**
Technology Use															
Computer for instructional delivery (e.g., CAI, drill & practice)	57.7	25.2	36.1	32.7	35.9	34.8	7.7	22.3	17.4	1.9	15.5	11.0	0.0	1.0	0.6
Technology as a learning tool or resource (e.g., Internet research, spreadsheet or database creation, multi-media, CD Rom, Laser disk)	50.0	23.3	32.3	44.2	38.8	40.6	5.8	24.3	18.1	0.0	13.6	9.0	0.0	0.0	0.0
Assessment															
Performance assessment strategies	96.2	90.3	92.3	3.8	9.7	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Student self-assessment (portfolios, individual record books)	92.3	92.2	92.3	7.7	5.8	6.5	0.0	1.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0
Summary Items							**Low**			**Moderate**			**High**		
							Fall	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**
Academically focused class time							1.9	0.0	0.6	28.8	16.5	20.6	69.2	82.5	78.1
Level of student attention/interest/engagement							1.9	1.0	1.3	57.7	38.8	45.2	40.4	59.2	52.9

[a] *NOTE: One school observation visit equals approximately 10 classroom visits.*

Number of School Observation Visits for Fall 2001-2002 N = 52
Number of School Observation Visits for Spring 2001-2002 N = 103
Number of Combined School Observation Visits for Total 2001-2002 N = 155

Table 4

Targeted SOM Descriptive Summary: Complete Rubric (Fall and Spring Combined)

Targeted SOM Aggregate Data[a]															
The extent to which each of the following was used or present in the school...	**Percent None**			**Percent Rarely**			**Percent Occasionally**			**Percent Frequently**			**Percent Extensively**		
	Fall	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**
Instructional Orientation															
Direct instruction (lecture)	15.4	30.8	25.6	19.2	24.0	22.4	25.0	16.3	19.2	21.2	13.5	16.0	19.2	15.4	16.7
Team teaching	80.8	86.5	84.6	7.7	1.9	3.8	3.8	1.0	1.9	3.8	4.8	4.5	3.8	5.8	5.1
Cooperative/collaborative learning	63.5	48.1	53.2	5.8	3.8	4.5	5.8	11.5	9.6	17.3	23.1	21.2	7.7	13.5	11.5
Individual tutoring (teacher, peer, aide, adult volunteer)	86.5	86.5	86.5	1.9	6.7	5.1	5.8	5.8	5.8	3.8	1.0	1.9	1.9	0.0	0.6
Classroom Organization															
Ability groups	92.3	84.6	87.2	1.9	1.0	1.3	0.0	1.0	0.6	0.0	1.0	0.6	5.8	12.5	10.3
Multi-age grouping	92.3	82.7	85.9	0.0	1.0	0.6	0.0	0.0	0.0	0.0	1.9	1.3	7.7	14.4	12.2
Work centers (for individuals or groups)	69.2	68.3	68.6	1.9	1.9	1.9	3.8	1.9	2.6	17.3	7.7	10.9	7.7	20.2	16.0
Instructional Strategies															
Higher level instructional feedback (written or verbal) to enhance student learning	51.9	63.5	59.6	19.2	13.5	15.4	13.5	10.6	11.5	9.6	5.8	7.1	3.8	6.7	5.8
Integration of subject areas (interdisciplinary/thematic units)	73.1	76.9	75.6	5.8	1.9	3.2	13.5	4.8	7.7	5.8	8.7	7.7	1.9	7.7	5.8
Project-based learning	84.6	58.7	67.3	1.9	2.9	2.6	1.9	3.8	3.2	3.8	15.4	11.5	7.7	19.2	15.4
Use of higher-level questioning strategies	65.4	56.7	59.6	13.5	15.4	14.7	3.8	14.4	10.9	13.5	6.7	9.0	3.8	5.8	5.1
Teacher acting as a coach/facilitator	21.2	11.5	14.7	9.6	5.8	7.1	17.3	13.5	14.7	36.5	30.8	32.7	15.4	36.5	29.5
Parent/community involvement in learning activities	94.2	96.2	95.5	0.0	1.0	0.6	1.9	1.0	1.3	1.9	1.0	1.3	1.9	1.0	1.3
Student Activities															
Independent seatwork (self-paced worksheets, individual assignments)	34.6	47.1	42.9	1.9	11.5	8.3	21.2	8.7	12.8	19.2	15.4	16.7	23.1	17.3	19.2
Experiential, hands-on learning	55.8	63.5	60.9	7.7	1.9	3.8	5.8	6.7	6.4	25.0	16.3	19.2	5.8	11.5	9.6
Systematic individual instruction (differential assignments geared to individual needs)	100.0	94.2	96.2	0.0	1.0	0.6	0.0	1.9	1.3	0.0	2.9	1.9	0.0	0.0	0.0
Sustained writing/composition (self-selected or teacher-generated topics)	82.7	83.7	83.3	1.9	1.9	1.9	7.7	6.7	7.1	7.7	3.8	5.1	0.0	3.8	2.6
Sustained reading	76.9	87.5	84.0	7.7	6.7	7.1	7.7	1.9	3.8	1.9	1.9	1.9	5.8	1.9	3.2
Independent inquiry/research on the part of students	80.8	56.7	64.7	1.9	5.8	4.5	3.8	7.7	6.4	9.6	13.5	12.2	3.8	16.3	12.2
Student discussion	80.8	71.2	74.4	7.7	6.7	7.1	1.9	5.8	4.5	5.8	11.5	9.6	3.8	4.8	4.5

Table 4

Targeted SOM Descriptive Summary: Complete Rubric (Fall and Spring), continued

Targeted SOM Aggregate Data[a]															
The extent to which each of the following was used or present in the school...	**Percent None**			**Percent Rarely**			**Percent Occasionally**			**Percent Frequently**			**Percent Extensively**		
	Fall	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**
Technology Use															
Computer for instructional delivery (e.g., CAI, drill & practice)	48.1	44.2	45.5	7.7	6.7	7.1	13.5	15.4	14.7	19.2	16.3	17.3	11.5	17.3	15.4
Technology as a learning tool or resource (e.g., Internet research, spreadsheet or database creation, multi-media, CD Rom, Laser disk)	32.7	14.4	20.5	3.8	1.9	2.6	9.6	8.7	9.0	26.9	26.0	26.3	26.9	49.0	41.7
Assessment															
Performance assessment strategies	94.2	95.2	94.9	1.9	0.0	0.6	0.0	1.9	1.3	1.9	1.0	1.3	1.9	1.9	1.9
Student self-assessment (portfolios, individual record books)	92.3	98.1	96.2	0.0	1.0	0.6	1.9	0.0	0.6	3.8	0.0	1.3	1.9	1.0	1.3
Summary Items							**Low**			**Moderate**			**High**		
							Fall	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**	**Fall**	**Spring**	**Cmb.**
Academically focused class time							7.7	0.0	2.6	13.5	10.6	11.5	75.0	89.4	84.6
Level of student attention/interest/engagement							3.8	0.0	1.3	28.8	15.4	19.9	63.5	84.6	77.6

[a] *NOTE: One targeted observation visit equals a one-hour classroom visit.*

Number of School Observation Visits for Fall 2001-2002 N = 52
Number of School Observation Visits for Spring 2001-2002 N = 104
Number of School Observation Visits for Combined Total 2001-2002 N = 156

To determine whether significant changes occurred from Fall to Spring, t-tests for independent samples were performed on each item. Tables 5 and 6 summarize the significant results for whole-school and targeted observations, respectively. As shown in Table 5, there were 9 significant items for the whole-school observations. All, except direct instruction and independent seatwork, showed higher frequency of observation in the Spring. It should be noted that the latter two strategies represent fairly traditional modes of instruction; in contrast, the strategies showing Spring increases, such as work centers, project-based learning, systematic individual instruction, and independent inquiry, tend to be more student-centered. Technology use and student attention/interest also increased over time.

For the targeted observations, there were seven significant items, one (direct instruction) favoring the Fall (see Table 6). The others, as for the whole-school observations, reflect student-centered learning (project-based, teacher coaching, independent inquiry), technology use, and greater academically-focused time and student attention/engagement.

Summary. The SOM results were revealing in showing usage of a variety of teaching strategies ranging from traditional (direct instruction and independent seatwork) to alternative (project-based learning, independent inquiry, technology as a learning tool). Importantly, in both the whole-school and targeted observations, inferential analyses indicated increases from fall to spring in student-centered teaching methods, usage of technology, and level of student engagement. The implication is that schools' involvement of TLCF contributed changes in teaching methods to promote technology integration and active learning.

Table 5

A Summary of Items Showing Significant Differences Between Whole-School Fall and Whole-School Spring Observations

	Regular Fall *(n=52)*		Regular Spring *(n=103)*				
Items	M	SD	M	SD	*t (153)*	*p*	*ES*
Direct Instruction	3.08	0.79	2.53	0.98	3.47	0.001**	0.60
Work Centers	0.65	0.81	1.01	1.09	2.28	0.025*	-0.36
Project-based Learning	0.27	0.49	0.65	0.83	3.55	0.001**	-0.52
Independent Seatwork	2.90	0.80	2.49	0.87	2.98	0.003**	0.48
Systematic Individual Instruction	0.06	0.23	0.23	0.60	2.49	0.014*	-0.34
Independent Inquiry/Research	0.25	0.44	0.60	0.77	3.56	0.000***	-0.51
Computer for Instructional Delivery	0.54	0.73	1.31	1.05	5.35	0.000***	-0.81
Technology as a Learning Tool	0.56	0.61	1.28	0.97	5.67	0.000***	-0.83
Student Attention/Interest/Engagement	2.38	0.53	2.59	0.51	2.30	0.023*	-0.40

**p<.05, **p<.01, ***p<.001*

Table 6

A Summary of Items Showing Significant Differences Between Targeted Fall and Targeted Spring

Items	Targeted Fall *(n=52)* M	Targeted Fall *(n=52)* SD	Targeted Spring *(n=104)* M	Targeted Spring *(n=104)* SD	*t (154)*	*p*	*ES*
Direct Instruction	2.10	1.35	1.59	1.44	2.13	0.035*	0.36
Project-based Learning	0.48	1.21	1.34	1.69	3.62	0.000***	-0.55
Teacher Acting as Coach-Facilitator	2.15	1.39	2.76	1.33	2.62	0.009*	-0.45
Independent Inquiry/Research	0.54	1.18	1.27	1.61	3.21	0.002**	-0.49
Technology as a Learning Tool	2.11	1.65	2.93	1.40	3.06	0.003**	-0.55
Academically Focused Class Time	2.70	0.61	2.89	0.31	2.11	0.039*	-0.44
Student Attention/Interest/Engagement	2.62	0.57	2.85	0.36	2.58	0.012*	-0.52

**p<.05, **p<.01, ***p<.001*

Expanded Rubric

The Expanded Rubric (ER) was used only in target observations. Thus, usage of technology to support learning was expected to be viewed at sometime during the lesson. Results address the percentage of sessions in which time each ER strategy was observed at least once, the quality/depth of observed strategy applications, and the percentage of sessions in which technology was used with the observed strategy.

Observed vs. not observed. The first question on each ER item asked participants whether or not the particular strategy was observed. Results are presented in Table 7. In the Fall, the most frequently observed strategy was producers of knowledge (73%), as might be expected given that this strategy entailed technology use, followed by higher-level questioning (48%), cooperative learning (44%), and experiential learning (44%). Least often observed was independent inquiry (26%). In the Spring, the most frequent were producers of knowledge (90%), cooperative learning (52%), and independent inquiry (47%); least frequent was student discussion (29%).

Formal analyses consisted of 2 (Observed: Yes/No) x 2 (Time Period: Fall/Spring) chi-square tests on each item. Significant outcomes, all showing higher Spring than Fall frequencies, were obtained for three strategies (see Table 7): project-based learning ($p < .001$), independent inquiry ($p < .01$), and producers of knowledge ($p < .01$).

Table 7

Percentage of Times Expanded Rubric Strategies were Observed or Not Observed During Targeted Observations

	Fall (n=52)		Spring (n=103)	
Strategies	Observed	Not	Observed	Not
Cooperative Learning	44.2	55.8	51.9	48.1
Project-Based Learning***	17.3	82.7	43.7	56.3
Higher Level Questioning Strategies	48.1	51.9	43.7	56.3
Experiential Hands-on Learning	44.2	55.8	36.5	63.5
Independent Inquiry/Research**	25.5	74.5	47.1	52.9
Student Discussion	28.8	71.2	29.1	70.9
Students as Producers of Knowledge**	72.5	27.5	90.4	9.6

*p<.05, **p<.01, ***p<.001

Rubric evaluation. The next set of analyses examined the rubric rating (1 to 4) for each of the strategies, when the given strategy was observed. That is, if the strategy was not seen, the associated rating of "0" was excluded from the analysis because it would seriously negatively bias the overall computation of quality/effectiveness. Table 8 presents a descriptive summary of the Fall and Spring means. All but one of the means (independent inquiry in Fall) range between approximately 1.80 and 2.90, suggesting moderate levels of quality/effectiveness. Notably, the relatively high means achieved in the Spring for project-based learning (M = 2.91) and experiential learning (M = 2.79) reflect relatively high attainment compared to typical schools. The lowest Spring rating was for students as producers of knowledge (M = 2.21), indicating room for growth in the integration of technology with leaning. However, the latter activities could certainly have been constrained by curriculum and state-mandated testing requirements that are most influential in the Spring semester.

Table 8

TLCF Expanded Rubric: Descriptive Statistics

	Fall (n=52)		Spring (n=104)	
	Mean	SD	Mean	SD
1. Cooperative Learning	2.26	1.01	2.78	0.86
2. Project-Based Learning	2.78	1.20	2.91	1.06
3. High-Level Questioning Strategies	2.08	0.95	2.51	0.97
4. Experiential/Hands-on Learning	2.35	0.98	2.79	0.87
5. Independent Inquiry/Research	1.46	0.66	2.41	1.04
6. Student Discussion	1.93	1.16	2.60	0.97
7. Students as Producers of Knowledge	1.86	1.06	2.21	1.07

Inferential analyses (*t* test for independent samples) were conducted to compare Fall-to-Spring rubric ratings. (MANOVA could not be used due to the very small number of cases in which all seven strategies were observed for the given session.) As summarized on Table 9, three analyses were significant, all indicating higher Spring than Fall means: cooperative learning (*ES* = -0.56), independent inquiry (*ES* = -0.91), and student discussion (*ES* = -0.63). The suggestion is that teachers were using these strategies more meaningfully and effectively over time.

Table 9

A Summary of Expanded Rubric Items Showing Significant Differences Between Fall and Spring

	Fall (*n*=52)		Spring (*n*=104)				
Component/Rating	Mean	SD	Mean	SD	t(75)	*p*	ES
Cooperative Learning	2.26	1.01	2.78	0.86	2.28	0.025*	-0.56
Independent Inquiry/Research	1.46	0.66	2.41	1.04	3.11	0.003**	-0.91
Student Discussion	1.93	1.16	2.60	0.97	2.04	0.048*	-0.63

**p<.05, **p<.01, ***p<.001*

Technology use. After each ER item, the respondent was asked to indicate whether or not technology was used in conjunction with the particular strategy. Table 10 summarizes the results for Fall and Spring. Aside from producers of knowledge, the technology-specific strategy, the highest frequency of use in the Fall was with cooperative learning (57%), and in the Spring with independent inquiry (94%) and project-based learning (94%). Chi-square tests of the relationship between Technology Use (yes or no) and Time Period (Fall or Spring) yielded significance on all strategies except student discussion and producers of knowledge. All significant results showed technology use to be higher in the Fall than in the Spring.

Table 10

Percentage of Times that Technology Was Used to Support the Strategy on the Expanded Rubric Fall vs. Spring

	Fall (n=52)		Spring (n=103)	
Strategies	Yes	No	Yes	No
Cooperative Learning**	57.1	42.9	86.0	14.0
Project-Based Learning***	47.1	52.9	93.5	6.5
Higher Level Questioning Strategies*	41.7	58.3	65.9	34.1
Experiential Hands-on Learning**	53.8	46.2	81.4	18.6
Independent Inquiry/Research***	55.0	45.0	93.8	6.3
Student Discussion	50.0	50.0	63.6	36.4
Students as Producers of Knowledge	94.7	5.3	98.9	1.1

*p<.05, **p<.01, ***p<.001

Open-ended comments. Table 11 presents a summary of teachers' open-ended comments regarding technology use in association with Expanded Rubric items. A review of the comments shows a wide variety of technology applications, which appear to be clearly more extensive in depth and scope in the Spring than in the Fall.

Table 11

Expanded Rubric Technology Usage Synthesis
(Data compiled from all 26 TLCF schools) 2001-2002

**This table summarizes how technology was used to support the seven areas (strategies) examined on the Expanded Rubric. The number in parentheses ( ) indicates the frequency of researcher noted activities within each technological category.*

Fall	Spring
Cooperative Learning	**Cooperative Learning**
▪ Instructional delivery (primarily using production tools) (e.g., completing math problems, writing personal letters) *(5)* ▪ Teaching software applications (e.g., spreadsheet, graphing) *(3)* ▪ Computer based simulation (e.g., stock market) *(3)* ▪ Fostering student discussion *(2)* ▪ Internet search/research tools *(2)*	▪ Internet search/research tools (e.g., projects, information gathering, answering teacher generated questions) *(24)* ▪ Teaching software applications *(6)* ▪ Teaching basic computing skills *(2)* ▪ Student presentations *(4)* ▪ Instructional delivery (e.g., math problems, sight words) *(3)* ▪ Cooperative learning skills (e.g., roles, jobs, rules) *(3)* ▪ Simulation/experiential learning *(2)* ▪ Student discussion *(1)*
Project-Based Learning	**Project-Based Learning**
▪ Internet search *(2)* ▪ Simulation/experiential learning (e.g. stock market, build roller coaster using math) *(2)* ▪ Student presentations/graphics *(2)* ▪ Research how to conduct projects *(1)* ▪ Instructional delivery (e.g., wrote and used grammatical rules) *(1)*	▪ Internet search (information gathering) *(17)* ▪ Student presentations (e.g. PowerPoint, word processing a story) *(8)* ▪ Graphics/Illustrations *(4)* ▪ Simulation/experiential learning (e.g., city planning, making a video, creating stock portfolios) *(5)* ▪ Instructional delivery (e.g., map of U.S., solar system) *(3)*
Higher-Level Questioning Strategies	**Higher-Level Questioning Strategies**
▪ Internet use (e.g., searches, on-line activities) *(3)* ▪ Presenting instructional material (teacher use) *(2)*	▪ Internet use (e.g., students answer teacher-posed questions; answer questions based on research/what is being viewed) *(10)* ▪ Presenting instructional material (teacher use) *(4)* ▪ Instructional delivery (student use) (e.g., vocabulary words, colors, symbols) *(3)* ▪ Calculator use *(2)* ▪ Teaching basic computing skills *(2)* ▪ How to display data *(1)* ▪ Interactive software *(1)* ▪ Concept mapping *(1)*
Experiential Hands-on Learning	**Experiential Hands-on Learning**
▪ Internet search/use *(5)* ▪ Instructional delivery (e.g., use computer to write letters, learn grammar, categories of animals) *(4)* ▪ Computer based simulations *(2)*	▪ Internet search/use *(7)* ▪ Computer based simulations (6) ▪ Learning computer skills *(6)* ▪ Presentations (student) *(3)* ▪ Instructional delivery (content area) (e.g., math; developing outlines; grouping) *(2)* ▪ Data analysis *(1)* ▪ Graphing calculator *(1)*

Table 11

Expanded Rubric Technology Usage Synthesis
(Data compiled from all 26 TLCF schools) 2001-2002, continued

Independent Inquiry/ Research	**Independent Inquiry/ Research**
▪ Internet/Research Tools (7) ▪ Educational software to develop a roller coaster *(1)*	▪ Internet/Research Tools *(31)* ▪ Creating presentations (e.g., research/project results, personal portfolios) *(4)* ▪ Educational software (e.g. math facts; health) *(2)* ▪ Story illustration (e.g., clipart) *(1)* ▪ Developing concept maps *(1)*
Student Discussion	**Student Discussion**
▪ Internet use (e.g., discussed search strategies; results of searches and Internet activities) *(4)* ▪ Computer based simulation (e.g., each student has assigned role; discussed results) *(1)* ▪ Student presentations (e.g., how to make presentations) *(1)*	▪ Internet use (e.g., discuss findings, search strategies) *(6)* ▪ Student presentations (e.g., how to make presentations; presenting results) *(4)* ▪ Presenting instructional material (teacher use) (e.g., present questions/topics via PowerPoint) *(3)* ▪ Peer tutoring/coaching (e.g., how to use the computer or a particular software application) *(3)*
Students as Producers of Knowledge	**Students as Producers of Knowledge**
▪ Internet/Research Tools *(14)* ▪ Production Tools (e.g., word processing, spreadsheet, graphics, presentation) *(14)* ▪ Simulation *(1)* ▪ Teaching basic computer skills *(1)* ▪ Tutorial software *(1)*	▪ Internet/Research Tools *(37)* ▪ Production tools (e.g., word processing, spreadsheet, graphics, presentation) *(23)* ▪ Tutorial software *(3)* ▪ Concept maps *(2)* ▪ Graphing calculator (e.g., solving math equations) *(2)* ▪ Simulation *(1)*

Survey of Computer Use (SCU)

Data from the SCU were collected for two whole-school and two targeted Fall observations and four whole-school and four targeted Spring observations. A summary of the observation results is provided in Table 12 to 15 for the two groups, respectively. Asterisks in the tables refer to significant differences in the Fall-Spring observation ratings derived from chi-square tests of independence. Tables 16 and 17 present combined results for the fall and spring.

Table 12

Survey of Computer Use Data Summary for Fall Whole-School Observations (n = 52)

Items	None	Few	Some	Most	All
Computer Capacity and Currency					
Classrooms with 1 computer	39.2%	27.5%	9.8%	19.6%	3.9%
Classrooms with 2 - 4 computers	7.7%	30.8%	25.0%	32.7%	3.8%
Classrooms with 5 or more computers	23.5%	43.1%	19.6%	11.8%	2.0%
Computers that were outdated and limited in capacity	31.4%	37.3%	25.5%	5.9%	0.0%
Computers that were aging but adequate	13.7%	15.7%	35.3%	33.3%	2.0%
Computers that were up-to-date**	4.0%	22.0%	38.0%	30.0%	6.0%
Computers with Internet access**	1.9%	9.6%	23.1%	42.3%	23.1%
Extent of Computer Use					
Computers used by nearly all (91-100%) students**	90.0%	10.0%	0.0%	0.0%	0.0%
Computers used by most (about 51-90%) students*	94.0%	4.0%	2.0%	0.0%	0.0%
Computers used by some (about 10-50%) students*	72.0%	14.0%	12.0%	2.0%	0.0%
Computers used by few (less than 10%) students	34.0%	34.0%	18.0%	6.0%	8.0%

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Computer Configuration					
Students worked alone at the computer***	22.0%	42.0%	8.0%	6.0%	22.0%
Students worked in pairs at the computer**	74.0%	18.0%	2.0%	4.0%	2.0%
Students worked in small groups at the computer	84.0%	12.0%	2.0%	0.0%	2.0%
Student were computer literate***	30.0%	24.0%	24.0%	20.0%	2.0%
Students easily used the keyboard***	28.0%	30.0%	20.0%	20.0%	2.0%
Production Tools Used by Students					
Word Processing	82.0%	8.0%	6.0%	2.0%	2.0%
Database	100.0%	0.0%	0.0%	0.0%	0.0%
Spreadsheet	96.0%	2.0%	2.0%	0.0%	0.0%
Draw/Paint/Graphics	86.0%	6.0%	4.0%	4.0%	0.0%
Presentation (e.g., MS PowerPoint)***	96.0%	2.0%	0.0%	0.0%	2.0%
Authoring (e.g., HyperStudio)	96.0%	2.0%	2.0%	0.0%	0.0%
Concept Mapping (e.g., Inspiration)	96.0%	2.0%	2.0%	0.0%	0.0%
Planning (e.g., MS Project)	100.0%	0.0%	0.0%	0.0%	0.0%
Internet/Research Tools Used by Students					
Internet Browser (e.g., Netscape)***	80.0%	16.0%	0.0%	0.0%	4.0%
CD Reference (encyclopedias, etc.)	98.0%	0.0%	2.0%	0.0%	0.0%
Communications	98.0%	2.0%	0.0%	0.0%	0.0%
Educational Software Used by Students					
Drill/Practice/Tutorial*	50.0%	34.0%	6.0%	10.0%	0.0%
Problem Solving (Oregon Trail, SimCity, etc.)	92.0%	6.0%	2.0%	0.0%	0.0%
Process Tools (Geometer's Sketchpad, etc.)	92.0%	4.0%	4.0%	0.0%	0.0%

Table 12

Survey of Computer Use Data Summary for Fall Whole-School Observations (n = 52), continued

Items	Other	Language	Mathematics	Science	S. Studies
Subject Areas of Computer Activities					
Production Tools	5.8%	30.8%	0.0%	5.8%	3.8%
Internet/Research Tools	3.8%	7.7%	0.0%	5.8%	3.8%
Educational Software	1.9%	28.8%	23.1%	7.7%	5.8%

OVERALL MEANINGFUL USE OF COMPUTER

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Level of Computer Use					
Low level use of computers**	38.0%	40.0%	10.0%	6.0%	6.0%
Somewhat meaningful use of computers**	66.0%	14.0%	10.0%	6.0%	4.0%
Meaningful use of computers*	82.0%	8.0%	4.0%	6.0%	0.0%
Very meaningful use of computers*	98.0%	2.0%	0.0%	0.0%	0.0%

**p<.05, **p<.01, ***p<.001*

Table 13

Survey of Computer Use Data Summary for Spring Whole-School Observations (n = 104)

Items	None	Few	Some	Most	All
Computer Capacity and Currency					
Classrooms with 1 computer	49.0%	21.0%	14.0%	13.0%	3.0%
Classrooms with 2 - 4 computers	15.5%	27.2%	23.3%	33.0%	1.0%
Classrooms with 5 or more computers	12.6%	39.8%	22.3%	13.6%	11.7%
Computers that were outdated and limited in capacity	32.7%	39.6%	19.8%	7.9%	0.0%
Computers that were aging but adequate	12.7%	29.4%	41.2%	13.7%	2.9%
Computers that were up-to-date**	2.9%	4.9%	26.5%	52.9%	12.7%
Computers with Internet access**	1.0%	0.0%	11.8%	58.8%	28.4%
Extent of Computer Use					
Computers used by nearly all (91-100%) students**	53.9%	33.3%	8.8%	2.9%	1.0%
Computers used by most (about 51-90%) students*	72.5%	18.6%	6.9%	2.0%	0.0%
Computers used by some (about 10-50%) students*	49.0%	16.7%	19.6%	14.7%	0.0%
Computers used by few (less than 10%) students	29.0%	35.0%	10.0%	15.0%	11.0%

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Computer Configuration					
Students worked alone at the computer***	12.9%	6.9%	12.9%	25.7%	41.6%
Students worked in pairs at the computer**	45.5%	34.7%	16.8%	2.0%	1.0%
Students worked in small groups at the computer	76.2%	17.8%	4.0%	1.0%	1.0%
Student were computer literate***	13.9%	4.0%	21.8%	49.5%	10.9%
Students easily used the keyboard***	14.9%	8.9%	30.7%	39.6%	5.9%
Production Tools Used by Students					
Word Processing	60.4%	12.9%	11.9%	12.9%	2.0%
Database	96.0%	3.0%	1.0%	0.0%	0.0%
Spreadsheet	93.0%	1.0%	4.0%	2.0%	0.0%
Draw/Paint/Graphics	78.2%	12.9%	6.9%	1.0%	1.0%
Presentation (e.g., MS PowerPoint)***	61.4%	28.7%	5.9%	3.0%	1.0%
Authoring (e.g., HyperStudio)	93.0%	6.0%	1.0%	0.0%	0.0%
Concept Mapping (e.g., Inspiration)	96.0%	3.0%	1.0%	0.0%	0.0%
Planning (e.g., MS Project)	100.0%	0.0%	0.0%	0.0%	0.0%
Internet/Research Tools Used by Students					
Internet Browser (e.g., Netscape)***	30.7%	26.7%	19.8%	18.8%	4.0%
CD Reference (encyclopedias, etc.)	93.1%	3.0%	4.0%	0.0%	0.0%
Communications	98.0%	0.0%	1.0%	1.0%	0.0%
Educational Software Used by Students					
Drill/Practice/Tutorial*	36.0%	24.0%	22.0%	15.0%	3.0%
Problem Solving (Oregon Trail, SimCity, etc.)	87.0%	10.0%	1.0%	2.0%	0.0%
Process Tools (Geometer's Sketchpad, etc.)	95.9%	2.0%	1.0%	0.0%	1.0%

Table 13

Survey of Computer Use Data Summary for Spring Whole-School Observations (n = 104), continued

Items	Other	Language	Mathematics	Science	S. Studies
Subject Areas of Computer Activities					
Production Tools	5.8%	35.9%	9.7%	16.5%	19.4%
Internet/Research Tools	5.8%	27.2%	9.7%	27.2%	31.1%
Educational Software	3.9%	40.8%	40.8%	12.6%	1.9%

OVERALL MEANINGFUL USE OF COMPUTER

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Level of Computer Use					
Low level use of computers**	43.4%	18.2%	18.2%	19.2%	1.0%
Somewhat meaningful use of computers**	30.3%	25.3%	19.2%	20.2%	5.1%
Meaningful use of computers*	52.5%	17.2%	16.2%	13.1%	1.0%
Very meaningful use of computers*	78.0%	11.0%	3.0%	4.0%	4.0%

*$p<.05$, **$p<.01$, ***$p<.001$

Table 14

Survey of Computer Use Data Summary for Fall Targeted Observations (n = 52)

Items	None	Few	Some	Most	All
Computer Capacity and Currency					
Classrooms with 1 computer	76.9%	5.8%	0.0%	1.9%	15.4%
Classrooms with 2 - 4 computers	74.5%	3.9%	5.9%	0.0%	15.7%
Classrooms with 5 or more computers	32.0%	4.0%	4.0%	0.0%	60.0%
Computers that were outdated and limited in capacity	72.5%	15.7%	9.8%	0.0%	2.0%
Computers that were aging but adequate	55.8%	13.5%	13.5%	11.5%	5.8%
Computers that were up-to-date	13.5%	13.5%	11.5%	17.3%	44.2%
Computers with Internet access	5.8%	3.8%	3.8%	17.3%	69.2%
Extent of Computer Use					
Computers used by nearly all (91-100%) students	40.4%	3.8%	0.0%	7.7%	48.1%
Computers used by most (about 51-90%) students	94.2%	0.0%	1.9%	1.9%	1.9%
Computers used by some (about 10-50%) students	84.6%	0.0%	1.9%	3.8%	9.6%
Computers used by few (less than 10%) students	84.6%	3.8%	1.9%	0.0%	9.6%

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Computer Configuration					
Students worked alone at the computer	47.1%	3.9%	2.0%	2.0%	45.1%
Students worked in pairs at the computer*	72.5%	3.9%	2.0%	3.9%	17.6%
Students worked in small groups at the computer	82.4%	0.0%	5.9%	2.0%	9.8%
Student were computer literate**	25.5%	9.8%	11.8%	43.1%	9.8%
Students easily used the keyboard	31.4%	7.8%	17.6%	33.3%	9.8%
Production Tools Used by Students					
Word Processing	72.5%	3.9%	3.9%	9.8%	9.8%
Database	98.0%	0.0%	0.0%	0.0%	2.0%
Spreadsheet	96.1%	0.0%	0.0%	2.0%	2.0%
Draw/Paint/Graphics	86.3%	2.0%	0.0%	2.0%	9.8%
Presentation (e.g., MS PowerPoint)	94.1%	2.0%	0.0%	0.0%	3.9%
Authoring (e.g., HyperStudio)	100.0%	0.0%	0.0%	0.0%	0.0%
Concept Mapping (e.g., Inspiration)	96.1%	0.0%	0.0%	0.0%	3.9%
Planning (e.g., MS Project)	100.0%	0.0%	0.0%	0.0%	0.0%
Internet/Research Tools Used by Students					
Internet Browser (e.g., Netscape)	52.9%	2.0%	2.0%	5.9%	37.3%
CD Reference (encyclopedias, etc.)	98.0%	2.0%	0.0%	0.0%	0.0%
Communications	98.0%	2.0%	0.0%	0.0%	0.0%
Educational Software Used by Students					
Drill/Practice/Tutorial	88.2%	2.0%	2.0%	2.0%	5.9%
Problem Solving (Oregon Trail, SimCity, etc.)	94.1%	2.0%	0.0%	2.0%	2.0%
Process Tools (Geometer's Sketchpad, etc.)	98.0%	0.0%	0.0%	2.0%	0.0%

Table 14

Survey of Computer Use Data Summary for Fall Targeted Observations (n = 52), continued

Items	Other	Language	Mathematics	Science	S. Studies
Subject Areas of Computer Activities					
Production Tools	7.7%	25.0%	7.7%	11.5%	7.7%
Internet/Research Tools	7.7%	13.5%	3.8%	19.2%	11.5%
Educational Software	0.0%	9.6%	5.8%	5.8%	1.9%

OVERALL MEANINGFUL USE OF COMPUTER

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Level of Computer Use					
Low level use of computers*	55.1%	8.2%	10.2%	10.2%	16.3%
Somewhat meaningful use of computers	65.3%	8.2%	8.2%	4.1%	14.3%
Meaningful use of computers**	61.7%	0.0%	14.9%	19.1%	4.3%
Very meaningful use of computers	89.4%	0.0%	4.3%	2.1%	4.3%

**p<.05, **p<.01, ***p<.001*

Table 15

Survey of Computer Use Data Summary for Spring Targeted Observations (n = 102)

Items	None	Few	Some	Most	All
Computer Capacity and Currency					
Classrooms with 1 computer	88.1%	3.0%	0.0%	0.0%	8.9%
Classrooms with 2 - 4 computers	81.0%	0.0%	1.0%	0.0%	18.0%
Classrooms with 5 or more computers	19.6%	1.0%	1.0%	0.0%	78.4%
Computers that were outdated and limited in capacity	87.0%	7.0%	4.0%	2.0%	0.0%
Computers that were aging but adequate	64.0%	17.0%	6.0%	6.0%	7.0%
Computers that were up-to-date	8.8%	6.9%	4.9%	18.6%	60.8%
Computers with Internet access	4.8%	3.8%	1.0%	13.5%	76.9%
Extent of Computer Use					
Computers used by nearly all (91-100%) students	27.5%	0.0%	1.0%	4.9%	66.7%
Computers used by most (about 51-90%) students	90.1%	0.0%	3.0%	1.0%	5.9%
Computers used by some (about 10-50%) students	91.0%	1.0%	2.0%	2.0%	4.0%
Computers used by few (less than 10%) students	89.2%	2.9%	0.0%	2.9%	4.9%

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Computer Configuration					
Students worked alone at the computer	25.2%	6.8%	5.8%	6.8%	55.3%
Students worked in pairs at the computer*	62.1%	7.8%	5.8%	17.5%	6.8%
Students worked in small groups at the computer	81.6%	5.8%	3.9%	1.9%	6.8%
Student were computer literate**	9.8%	2.0%	14.7%	46.1%	27.5%
Students easily used the keyboard	17.6%	5.9%	16.7%	40.2%	19.6%
Production Tools Used by Students					
Word Processing	82.2%	1.0%	3.0%	5.0%	8.9%
Database	98.0%	0.0%	2.0%	0.0%	0.0%
Spreadsheet	91.1%	2.0%	0.0%	3.0%	4.0%
Draw/Paint/Graphics	87.1%	0.0%	4.0%	2.0%	6.9%
Presentation (e.g., MS PowerPoint)	80.4%	3.9%	2.9%	5.9%	6.9%
Authoring (e.g., HyperStudio)	100.0%	0.0%	0.0%	0.0%	0.0%
Concept Mapping (e.g., Inspiration)	96.0%	1.0%	0.0%	0.0%	3.0%
Planning (e.g., MS Project)	99.0%	0.0%	1.0%	0.0%	0.0%
Internet/Research Tools Used by Students					
Internet Browser (e.g., Netscape)	38.8%	1.0%	1.9%	11.7%	46.6%
CD Reference (encyclopedias, etc.)	93.1%	1.0%	3.0%	1.0%	2.0%
Communications	98.0%	1.0%	0.0%	0.0%	1.0%
Educational Software Used by Students					
Drill/Practice/Tutorial	78.2%	4.0%	5.0%	5.0%	7.9%
Problem Solving (Oregon Trail, SimCity, etc.)	92.9%	2.0%	0.0%	3.0%	2.0%
Process Tools (Geometer's Sketchpad, etc.)	98.0%	1.0%	0.0%	0.0%	1.0%

Table 15

Survey of Computer Use Data Summary for Spring Targeted Observations (n = 102), continued

Items	Other	Language	Mathematics	Science	S. Studies
Subject Areas of Computer Activities					
Production Tools	1.9%	20.2%	6.7%	13.5%	8.7%
Internet/Research Tools	2.9%	11.5%	11.5%	24.0%	26.0%
Educational Software	3.8%	8.7%	13.5%	2.9%	3.8%

OVERALL MEANINGFUL USE OF COMPUTER

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Level of Computer Use					
Low level use of computers*	79.6%	5.4%	4.3%	4.3%	6.5%
Somewhat meaningful use of computers	51.6%	6.3%	5.3%	12.6%	24.2%
Meaningful use of computers**	51.0%	4.2%	5.2%	11.5%	28.1%
Very meaningful use of computers	72.3%	3.2%	4.3%	7.4%	12.8%

**p<.05, **p<.01, ***p<.001*

Table 16

Survey of Computer Use Data Summary for Fall and Spring Combined Whole-School Observations (n = 156)

Items	None	Few	Some	Most	All
Computer Capacity and Currency					
Classrooms with 1 computer	45.7%	23.2%	12.6%	15.2%	3.3%
Classrooms with 2 - 4 computers	12.9%	28.4%	23.9%	32.9%	1.9%
Classrooms with 5 or more computers	16.2%	40.9%	21.4%	13.0%	8.4%
Computers that were outdated and limited in capacity	32.2%	38.8%	21.7%	7.2%	0.0%
Computers that were aging but adequate	13.1%	24.8%	39.2%	20.3%	2.6%
Computers that were up-to-date	3.3%	10.5%	30.3%	45.4%	10.5%
Computers with Internet access	1.3%	3.2%	15.6%	53.2%	26.6%
Extent of Computer Use					
Computers used by nearly all (91-100%) students	64.5%	25.2%	5.8%	1.9%	0.6%
Computers used by most (about 51-90%) students	79.6%	13.8%	5.3%	1.3%	0.0%
Computers used by some (about 10-50%) students	56.6%	15.8%	17.1%	10.5%	0.0%
Computers used by few (less than 10%) students	30.7%	34.7%	12.7%	12.0%	10.0%

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Computer Configuration					
Students worked alone at the computer	15.9%	18.5%	11.3%	19.2%	35.1%
Students worked in pairs at the computer	55.0%	29.1%	11.9%	2.6%	1.3%
Students worked in small groups at the computer	78.8%	15.9%	3.3%	0.7%	1.3%
Student were computer literate	19.2%	10.6%	22.5%	39.7%	7.9%
Students easily used the keyboard	19.2%	15.9%	27.2%	33.1%	4.6%
Production Tools Used by Students					
Word Processing	67.5%	11.3%	9.9%	9.3%	2.0%
Database	97.4%	2.0%	0.7%	0.0%	0.0%
Spreadsheet	94.0%	1.3%	2.7%	2.0%	0.0%
Draw/Paint/Graphics	80.8%	10.6%	6.0%	2.0%	0.7%
Presentation (e.g., MS PowerPoint)	72.8%	19.9%	4.0%	2.0%	1.3%
Authoring (e.g., HyperStudio)	94.0%	4.7%	1.3%	0.0%	0.0%
Concept Mapping (e.g., Inspiration)	96.0%	2.7%	1.3%	0.0%	0.0%
Planning (e.g., MS Project)	100.0%	0.0%	0.0%	0.0%	0.0%
Internet/Research Tools Used by Students					
Internet Browser (e.g., Netscape)	47.0%	23.2%	13.2%	12.6%	4.0%
CD Reference (encyclopedias, etc.)	94.7%	2.0%	3.3%	0.0%	0.0%
Communications	98.0%	0.7%	0.7%	0.7%	0.0%
Educational Software Used by Students					
Drill/Practice/Tutorial	40.7%	27.3%	16.7%	13.3%	2.0%
Problem Solving (Oregon Trail, SimCity, etc.)	88.7%	8.7%	1.3%	1.3%	0.0%
Process Tools (Geometer's Sketchpad, etc.)	94.6%	2.7%	2.0%	0.0%	0.7%

Table 16

Survey of Computer Use Data Summary for Fall and Spring Combined Whole-School Observations (n = 156), continued

Items	Other	Language	Mathematics	Science	S. Studies
Subject Areas of Computer Activities					
Production Tools	5.8%	34.2%	6.5%	12.9%	14.2%
Internet/Research Tools	5.2%	20.6%	6.5%	20.0%	21.9%
Educational Software	3.2%	36.8%	34.8%	11.0%	3.2%

OVERALL MEANINGFUL USE OF COMPUTER

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Level of Computer Use					
Low level use of computers	41.6%	25.5%	15.4%	14.8%	2.7%
Somewhat meaningful use of computers	42.3%	21.5%	16.1%	15.4%	4.7%
Meaningful use of computers	62.4%	14.1%	12.1%	10.7%	0.7%
Very meaningful use of computers	84.7%	8.0%	2.0%	2.7%	2.7%

Table 17

Survey of Computer Use Data Summary for Fall and Spring Combined Targeted Classrooms (n = 156)

Items	None	Few	Some	Most	All
Computer Capacity and Currency					
Classrooms with 1 computer	84.3%	3.9%	0.0%	0.7%	11.1%
Classrooms with 2 - 4 computers	78.8%	1.3%	2.6%	0.0%	17.2%
Classrooms with 5 or more computers	23.7%	2.0%	2.0%	0.0%	72.4%
Computers that were outdated and limited in capacity	82.1%	9.9%	6.0%	1.3%	0.7%
Computers that were aging but adequate	61.2%	15.8%	8.6%	7.9%	6.6%
Computers that were up-to-date	10.4%	9.1%	7.1%	18.2%	55.2%
Computers with Internet access	5.1%	3.8%	1.9%	14.7%	74.4%
Extent of Computer Use					
Computers used by nearly all (91-100%) students	31.4%	1.3%	0.6%	5.8%	59.6%
Computers used by most (about 51-90%) students	91.5%	0.0%	2.6%	1.3%	4.6%
Computers used by some (about 10-50%) students	88.8%	0.7%	2.0%	2.6%	5.9%
Computers used by few (less than 10%) students	87.7%	3.2%	0.6%	1.9%	6.5%

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Computer Configuration					
Students worked alone at the computer	32.5%	5.8%	4.5%	5.2%	51.9%
Students worked in pairs at the computer	65.6%	6.5%	4.5%	13.0%	10.4%
Students worked in small groups at the computer	81.8%	3.9%	4.5%	1.9%	7.8%
Student were computer literate	15.0%	4.6%	13.7%	45.1%	21.6%
Students easily used the keyboard	22.2%	6.5%	17.0%	37.9%	16.3%
Production Tools Used by Students					
Word Processing	78.9%	2.0%	3.3%	6.6%	9.2%
Database	98.1%	0.0%	1.3%	0.0%	0.7%
Spreadsheet	92.8%	1.3%	0.0%	2.6%	3.3%
Draw/Paint/Graphics	86.8%	0.7%	2.6%	2.0%	7.9%
Presentation (e.g., MS PowerPoint)	85.0%	3.3%	2.0%	3.9%	5.9%
Authoring (e.g., HyperStudio)	100.0%	0.0%	0.0%	0.0%	0.0%
Concept Mapping (e.g., Inspiration)	96.0%	0.7%	0.0%	0.0%	3.3%
Planning (e.g., MS Project)	99.3%	0.0%	0.7%	0.0%	0.0%
Internet/Research Tools Used by Students					
Internet Browser (e.g., Netscape)	43.5%	1.3%	1.9%	9.7%	43.5%
CD Reference (encyclopedias, etc.)	94.7%	1.3%	2.0%	0.7%	1.3%
Communications	98.0%	1.3%	0.0%	0.0%	0.7%
Educational Software Used by Students					
Drill/Practice/Tutorial	81.6%	3.3%	3.9%	3.9%	7.2%
Problem Solving (Oregon Trail, SimCity, etc.)	93.3%	2.0%	0.0%	2.7%	2.0%
Process Tools (Geometer's Sketchpad, etc.)	98.0%	0.7%	0.0%	0.7%	0.7%

Table 17

Survey of Computer Use Data Summary for Fall and Spring Combined Targeted Classrooms (n = 156), continued

Items	Other	Language	Mathematics	Science	S. Studies
Subject Areas of Computer Activities					
Production Tools	3.8%	21.8%	7.1%	12.8%	8.3%
Internet/Research Tools	4.5%	12.2%	9.0%	22.4%	21.2%
Educational Software	2.6%	9.0%	10.9%	3.8%	3.2%

OVERALL MEANINGFUL USE OF COMPUTER

Items	Not Observed	Rarely	Occasionally	Frequently	Extensively
Level of Computer Use					
Low level use of computers	71.1%	6.3%	6.3%	6.3%	9.9%
Somewhat meaningful use of computers	56.3%	6.9%	6.3%	9.7%	20.8%
Meaningful use of computers	54.5%	2.8%	8.4%	14.0%	20.3%
Very meaningful use of computers	78.0%	2.1%	4.3%	5.7%	9.9%

Computer capacity and currency. For this area, we will refer to descriptive results from the whole-school observations, because they are more reflective of the technology that might be found in typical classrooms (where teachers are not expecting to demonstrate a technology-based lesson). As can be seen in Table 12, approximately 14% of the observations conducted in the Fall indicated that "most" or "all" classrooms had five or more computers; in the spring, this percentage increased to 25%. Conversely, the percentages of classrooms with only one computer were greater in the Fall than in the Spring. Up-to-date computers were seen in most or all classrooms in about one-third of the Fall visits and close to two-thirds of the Spring visits. Internet access was common in both observation periods, but especially in the Spring (87% most or all).

Inferential fall-to-spring chi-square tests on whole-school observations yielded significant effects, favoring the Spring on (a) up-to-date computers ($p < .01$) and (b) Internet access ($p < .01$). No significant effects were found for the targeted observations.

Extent of computer use. During the whole-school visits, computers were observed being used by nearly all students in at least "some" classrooms in 0% of the visits in the Fall and in 13% of the visits in the Spring (Tables 12 and 13). Three of the four chi-square tests were significant on items concerning student usage ($p < .05$). All reflected a tendency for greater percentages of students to be using computers in the Spring. Similar trends were indicated for the targeted observations (Tables 14 and 15).

Computer configuration. Whole school observations in the Spring showed significant increases relative to the Fall in students: (a) working alone at the computer ($p < .001$), (b) working in pairs ($p < .01$), (c) being computer literate ($p < .001$), and (d) easily using the

keyboard ($p < .001$). For example, the percentage of visits in which students working alone was observed frequently or extensively was 28% in the Fall but 67% in the Spring. Targeted observations (see Tables 14 and 15) also reflected Spring gains, but significance was indicated on students working in pairs ($p < .05$) and being computer literate ($p < .01$) only.

Production tools used by students. As shown in Tables 12 and 13, students observed during whole-school observations used relatively few production tools of any type. In the Spring, the level was still low, although presentation software significantly increased ($p < .001$) relative to the Fall (*not* observed %'s = 96% and 61% in the Fall and Spring, respectively). The most frequently observed production tool was word processing (frequent or extensive usage in 15% of spring visits). Targeted observations (Tables 14 and 15) showed no differences between Fall and Spring observations, but relative to the whole-class assessments showed a broader range of, but still infrequent, production tool use (e.g., some word-processing, spreadsheet, draw/paint/graphics, and presentation).

Internet/research tools used by students. CD reference and process tools were hardly ever observed across all types of observation visits . On the other hand, usage of the Internet was observed frequently or extensively in close to 25% of the Spring whole-school visits, a significant increase from the Fall ($p < .001$). No differences were found in Internet use in the targeted visits, although the Spring observations showed frequent or extensive use in 58% of the visits compared to 43% in the Fall.

Educational software use by students. Whole-school observations indicated that drill-and-practice software use was significantly more likely to be observed in Spring than in Fall visits ($p < .05$). Usage of problem-solving tools or process tools was rare. Targeted observations similarly showed limited usage of drill-and-practice software, but no Fall-to-Spring differences.

Subject areas of computer activities. No differences were found in either whole-school or targeted observations between Fall and Spring computer applications to different subject areas. Production tools tended to be used more frequently in language arts than in other subjects. Internet and educational software usage occurred to some degree in language arts, science, and social studies.

Level of computer use. In this culminating item, significant differences (all p's $< .05$) between Fall and Spring whole-school observations were found for all four levels of the rating scale. The direction of the data shows progression toward more meaningful applications in the Spring. For example, "very meaningful applications" were at least occasionally observed in 11% of the Spring visits but in none of the Fall visits; "meaningful" usage was observed occasionally or more in 30% of the Spring visits but in only 10% of the Fall visits. The targeted observations showed two significant contrasts between Fall and Spring: low-level use was more frequent in the Fall; meaningful use was more frequent in the Spring.

Summary. The SCU results indicate progress in teachers' integration of technology at the TLCF schools. Specifically, in comparisons from the Fall to the Spring, there were significant increases in individual student use of computers, student computer skills, use of presentation software, use of the Internet, and, perhaps most importantly, meaningful use (integration) of

technology with classroom instruction. Less expected given the goals of TLCF, there were also significant increases in drill-and-practice software usage, although such might be explained by (a) a generalized effect of classrooms becoming more technology rich and (b) perceived benefits of such software for preparing students for the spring TCAP testing.

Teacher Technology Questionnaire

Descriptive results. Fall and Spring results on the Teacher Technology Questionnaire are summarized in Table 18. Immediately noticeable are the more favorable attitudes conveyed in the Spring. For example, in the Fall, no items received 70% or more agreement, whereas, in the Spring, 17 out of 20 items received that level. The three items not included are: my teaching is more student-centered with technology (67% agree), I routinely integrate technology (69%), and my teaching is more interactive with technology (68%).

Table 18

Teacher Technology Questionnaire (TTQ) Data Summary for Fall and Spring

TTQ Aggregate Data						
TTQ Item	Percent Strongly Agree and Agree		Percent Neutral		Percent Disagree and Strongly Disagree	
	Fall	Spring	Fall	Spring	Fall	Spring
1. Most of our school computers are kept in good working condition.	66.2	85.3	17.9	8.9	15.3	5.6
2. I can readily obtain answers to technology-related questions.	68.3	84.9	18.4	8.4	13.0	6.5
3. The use of computers has increased the level of student interaction and/or collaboration.	51.6	85.1	34.6	11.5	12.9	3.2
4. Parents and community members support our school's emphasis on technology.	64.0	75.2	29.2	21.2	6.1	3.4
5. I know how to meaningfully integrate technology into lessons.	44.4	82.2	27.0	12.4	27.6	5.0
6. My students have adequate access to up-to-date technology resources.	46.3	79.6	23.3	10.4	28.9	9.3
7. Materials (e.g., software, printer supplies) for classroom use of computers are readily available.	43.6	73.1	21.1	13.0	34.5	13.6
8. The integration of technology has positively impacted student learning and achievement.	53.7	83.7	34.9	13.0	10.7	2.6
9. I am able to align technology use with my district's standards-based curriculum.	38.5	73.6	36.4	21.2	23.7	4.6
10. Most of my students can capably use computers at an age-appropriate level.	60.7	87.4	21.1	8.0	16.7	4.2
11. I have received adequate training to incorporate technology into my instruction.	39.3	83.5	27.7	11.6	31.6	4.3
12. My computer skills are adequate to conduct classes that have students using technology.	53.4	83.2	18.7	10.5	27.0	5.7
13. Teachers receive adequate administrative support to integrate technology into classroom practices.	62.2	87.9	24.5	8.6	12.6	3.4
14. My teaching is more student-centered when technology is integrated into the lessons.	37.8	66.5	44.1	25.2	16.6	7.9
15. Our school has a well-developed technology plan that guides all technology integration efforts.	52.7	82.2	29.7	13.9	16.7	3.7
16. I routinely integrate the use of technology into my instruction.	34.4	68.8	25.1	18.3	38.6	12.4
17. Teachers in this school are generally supportive of technology integration efforts.	68.8	84.3	22.6	11.8	7.8	3.5
18. Technology integration efforts have changed classroom learning activities in a very positive way.	55.9	83.4	35.0	13.7	7.8	2.6
19. The use of technology has improved the quality of student work.	40.5	70.0	45.1	24.4	13.3	5.6
20. My teaching is more interactive when technology is integrated into the lessons.	40.9	68.2	41.7	23.3	16.6	8.3

Number of Respondents for Fall 2001-2002 N = 1135
Number of Respondents for Spring 2001-2002 N = 1133

Inferential results. Inferential analyses, using MANOVA, confirmed the impression of more favorable Spring responses. The MANOVA, treating the 20 items as dependent measures, was highly significant, $F(20, 2052) = 51.28$, $p < .0001$. Follow-up univariate analyses yielded significance on all 20 items (see Table 19). Those with Effect Sizes greater in absolute value than 0.80, indicating a very strong effect, were for: use of computers increasing level of student interaction/collaboration (*ES* = -0.85), I know how to integrate technology (*ES* = -0.88), technology has positively impacted student learning and achievement (*ES* = -0.81), I am able to align technology use with curriculum (*ES* = -0.90), I have received adequate technology training (*ES* = -1.15), and I routinely integrate technology with instruction (*ES* = -0.80). (Readers should note that the negative Effect Sizes here indicate higher Spring than Fall means.)

Table 19

Univariate Results on the Teacher Technology Questionnaire for Fall and Spring

	Fall (*n*=1135)		Spring (*n*=1133)				
Items	Mean	SD	Mean	SD	F (1,2071)	*p*	ES
1. Most of our school computers are in good working condition.	3.65	0.97	4.12	0.82	145.07	0.000	-0.52
2. I can readily obtain answers to technology-related questions	3.70	0.93	4.15	0.86	130.41	0.000	-0.50
3. The use of computers has increased the level of student interaction and/or collaboration.	3.48	0.89	4.19	0.78	417.79	0.000	-0.85
4. Parents and community members support our school's emphasis on technology.	3.75	0.83	4.02	0.81	57.51	0.000	-0.32
5. I know how to meaningfully integrate technology into lessons.	3.22	1.04	4.04	0.81	435.81	0.000	-0.88
6. My students have adequate access to up-to-date technology standards.	3.20	1.08	4.00	0.94	336.06	0.000	-0.79
7. Materials (e.g. software, printer supplies) for classroom use of computers are readily available.	3.11	1.10	3.85	1.02	266.02	0.000	-0.70
8. The integration of technology has positively impacted student learning and achievement	3.52	0.85	4.18	0.77	361.43	0.000	-0.81
9. I am able to align technology use with my district's standards-based curriculum	3.17	0.91	3.95	0.82	430.48	0.000	-0.90
10. Most of my students can capably use computers at an age-appropriate level.	3.54	0.95	4.18	0.77	287.43	0.000	-0.74
11. I have received adequate training to incorporate technology into my instruction.	3.08	1.02	4.14	0.81	684.26	0.000	-1.15
12. My computer skills are adequate to conduct classes that have students using technology.	3.35	1.10	4.09	0.83	287.77	0.000	-0.76
13. Teachers receive adequate administrative support to integrate technology into classroom practices.	3.62	0.92	4.23	0.76	283.77	0.000	-0.72
14. My teaching is more student-centered when technology is integrated into lessons.	3.25	0.86	3.81	0.92	222.56	0.000	-0.63
15. Our school has a well-developed technology plan that guides all technology integration efforts.	3.46	0.96	4.11	0.79	303.18	0.000	-0.74
16. I routinely integrate the use of technology into my instruction.	2.96	1.06	3.78	0.97	366.39	0.000	-0.80
17. Teachers in this school are generally supportive of technology integration efforts.	3.72	0.78	4.09	0.76	131.17	0.000	-0.48
18. Technology integration efforts have changed classroom learning activities in a very positive way.	3.55	0.79	4.14	0.77	305.02	0.000	-0.76
19. The use of technology has improved the quality of student work.	3.32	0.81	3.86	0.83	242.15	0.000	-0.66
20. My teaching is more interactive when technology is integrated into the lessons.	3.29	0.87	3.84	9.27	217.33	0.000	-0.61

Note: 1= Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

Summary. The results of the Teacher Technology Questionnaire demonstrate very strong teacher support for the TLCF goals, particularly with regard to technology integration with curriculum, lesson planning, and instructional delivery. Considering the very large and seemingly representative sample of respondents (Spring n = 1,133), the reactions are strikingly positive and indicative of high satisfaction with professional development, coaching support, student activities, and impacts on the quality of instruction. The inferential analyses yielded highly significant outcomes reflecting positive attitude changes from the Fall to Spring assessments.

School Climate Inventory

A full summary of SCI results, showing the seven dimension means and percent agreement on all 49 items, are provided in Appendix A. For present purposes, we will report on the overall dimension findings, as summarized in Table 20. Results show generally positive attitudes about school climate by teachers across the 26 schools. All means exceed the middle (undecided) rating of 3.00. Even the lowest mean of 3.47 indicated on the Order dimension is noticeably higher than that usually obtained in this area (typically, schools average close to 2.75). The two highest means are for Instruction (M = 4.04) and Leadership (M = 3.99). Overall, these results show that the TLCF schools were not debilitated by negative climate factors and had established generally facilitative environments for promoting change. What cannot be ascertained from this single administration of the SCI is the extent to which school climate was enhanced by the apparently positive experiences that teachers had (see Teacher Technology Questionnaire results) with the TLCF program.

Table 20

Dimensions and Overall mean on the School Climate Inventory

TLCF Aggregate Data	
	2001-2002
Collaboration	3.77
Environment	3.93
Expectations	3.88
Instruction	4.04
Involvement	3.81
Leadership	3.99
Order	3.47
OVERALL	3.84
Number of Respondents	1153

Technology Coach Survey

The Technology Coach Survey was administered in the Spring only. Thus, only descriptive analyses were performed. Results are summarized on Table 21. The first section of the table presents demographic data. The typical (or most representative) respondent in the population of 26 coaches was female (86%), between ages of 36-55 (65%), with 5-10 years of experience teaching (42%) and 5-10 years experience with technology (44%), working in a elementary school (46%) located in a small town (46%) with 50 or more teachers (42%).

Goal attainment and involvement. Coaches were asked to rate the degree to which each of the four goals was attained and their degree of involvement in achieving the goal. As shown in the last column ("Fully") of the TLCF Goals section of the table, the order in which the goals were perceived as being fully obtained were Goal 3 (Internet connection; 85%), Goal 2 (modern multimedia computers; 77%), Goal 4 (effective software and online resources; 50%), and Goal 1 (all teachers have training and support; 42%). However, from 92-96% of the teachers rated each goal attainment as either 4 (>Somewhat) or 5 (Fully) on the rating scale, thus indicating an impression of at least moderate to high implementation progress. With regard to involvement, 96% of the coaches perceived themselves to be fully involved in Goal 1 (the training component). Still high, but lower percentages rated themselves as fully involved with Goal 2 (85%) and Goal 4 (81%). Lesser involvement was perceived on Goal 3 (42%), with 19% not involved at all.

Table 21

Descriptive Results from TLCF Technology Coach Survey

Demographic Data		
What is your gender?	Frequency	Percent
Male	3	11.5
Female	23	88.5
What is your age?	Frequency	Percent
Under 25	0	0.0
25-35	8	30.8
36-45	8	30.8
46-55	9	34.6
56+	1	3.8
Environment		
What is your current school?	Frequency	Percent
School Setting		
Urban	7	26.9
Small Town	12	46.2
Rural	7	26.9
Number of Teachers		
20 or less	1	3.8
21-30	3	11.5
31-40	7	26.9
41-50	4	15.4
50 or more	11	42.3
Grade Levels (May check more than one)		
pre-k	7	26.9
K	14	53.8
1	14	53.8
2	14	53.8
3	14	53.8
4	14	53.8
5	11	42.3
6	7	26.9
7	8	30.8
8	8	30.8
9	6	23.1
10	5	19.2
11	5	19.2
12	5	19.2

Table 21

Descriptive Results from TLCF Technology Coach Survey, continued

What are your years of experience? (Percent of respondents)		Less than 5	5-10	11-20	21+
Years of teaching experience prior to this coaching position		15.4	42.3	7.7	34.6
Years of teaching experience with technology		28.0	44.0	24.0	4.0
	Lang. Arts	Math	Science	Soc. St.	Other
Primary Content Previously Taught (% of respondents)	53.8	53.8	53.8	46.2	38.5
	Elementary	Middle	High Sch.	Elem/Midd	Fac/Staff
Primary grade level in which you taught (% of respondents)	46.2	19.2	19.2	11.5	3.8

TLCF Goals

	Not		Somewhat		Fully
1a: To what degree has your school achieved Goal 1?	0.0	0.0	7.7	50.0	42.3
1b: To what degree were **you** involved in achieving Goal 1?	0.0	0.0	0.0	4.0	96.0
2a: To what degree has your school achieved Goal 2?	0.0	0.0	3.8	19.2	76.9
2b: To what degree were **you** involved in achieving Goal 2?	3.8	0.0	3.8	7.7	84.6
3a: To what degree has your school achieved Goal 3?	0.0	0.0	3.8	11.5	84.6
3b: To what degree were **you** involved in achieving Goal 3?	19.2	11.5	19.2	7.7	42.3
4a: To what degree has your school achieved Goal 4?	0.0	0.0	11.5	38.5	50.0
4b: To what degree were **you** involved in achieving Goal 4?	0.0	0.0	3.8	15.4	80.8

Table 21

Descriptive Results from TLCF Technology Coach Survey, continued

Technology Coach Responsibilities	Not		Somewhat		Extensively
How Frequently were you involved with each task?					
5. Set up and load software on computers	0.0	4.2	20.8	33.3	41.7
6. Set up/ Maintain Networks	28.0	24.0	28.0	8.0	12.0
7. Order Hardware/Software	4.3	0.0	8.7	26.1	60.9
8. Trouble shoot classroom and/or lab computers	0.0	0.0	20.0	36.0	44.0
9. Design technology training sessions	0.0	0.0	0.0	0.0	100.0
10. Assist teachers with computer skills	0.0	0.0	0.0	12.0	88.0
11. Assist students with computer skills	4.0	4.0	44.0	32.0	16.0
12. Assist administration with computer skills	4.0	12.0	40.0	28.0	16.0
13. Assist school staff with computer skills	12.0	4.0	44.0	24.0	16.0
14. Assist parents with computer skills	4.0	44.0	36.0	16.0	0.0
15. Coach teachers to use technology in their classrooms	0.0	0.0	0.0	8.0	92.0
16. Model technology integration lessons	0.0	4.0	24.0	36.0	36.0
17. Develop technology in their classrooms	0.0	8.3	50.0	16.7	25.0
18. Locate web-based Technology Integration materials for Teachers	0.0	0.0	16.0	28.0	56.0
19. Review/recommend software to teachers	0.0	12.0	24.0	20.0	44.0
20. Visit other schools to observe technology efforts	32.0	20.0	40.0	4.0	4.0
21. Invite exemplary teachers to provide workshops	4.0	16.0	48.0	12.0	20.0
22. Attend technology training	0.0	8.3	33.3	20.8	37.5
23. Attend Educational Conferences	4.0	4.0	56.0	8.0	28.0
24. Provide motivation for technology integration efforts	0.0	0.0	0.0	12.5	87.5
25. Provide one-on-one tech training to teachers	0.0	0.0	16.0	16.0	68.0
26. Provide small group tech training	0.0	0.0	4.0	12.0	84.0
27. Provide whole school/large group training.	4.0	20.0	32.0	16.0	28.0

Technology Coach Responsibilities	Not		Somewhat		Extensively
Degree to which task supported technology integration efforts					
5. Set up and load software on computers	0.0	0.0	20.8	20.8	58.3
6. Set up/ Maintain Networks	8.3	4.2	16.7	20.8	50.0
7. Order Hardware/Software	0.0	0.0	4.2	8.3	87.5
8. Trouble shoot classroom and/or lab computers	0.0	4.0	16.0	28.0	52.0
9. Design technology training sessions	0.0	0.0	0.0	0.0	100.0
10. Assist teachers with computer skills	0.0	0.0	0.0	12.0	88.0
11. Assist students with computer skills	0.0	4.0	24.0	16.0	56.0
12. Assist administration with computer skills	8.0	16.0	44.0	16.0	16.0
13. Assist school staff with computer skills	12.0	12.0	36.0	20.0	20.0
14. Assist parents with computer skills	20.0	16.0	24.0	24.0	16.0
15. Coach teachers to use technology in their classrooms	0.0	0.0	0.0	8.0	92.0
16. Model technology integration lessons	0.0	4.0	8.0	4.0	84.0
17. Develop technology in their classrooms	0.0	8.3	16.7	20.8	54.2
18. Locate web-based Technology Integration materials for Teachers	0.0	0.0	4.0	12.0	84.0
19. Review/recommend software to teachers	0.0	12.0	8.0	12.0	68.0

Table 21

Descriptive Results from TLCF Technology Coach Survey, continued

Technology Coach Responsibilities	Not		Somewhat		Extensively
20. Visit other schools to observe technology efforts	21.7	8.7	17.4	21.7	30.4
21. Invite exemplary teachers to provide workshops	4.2	4.2	29.2	16.7	45.8
22. Attend technology training	0.0	0.0	4.0	12.0	84.0
23. Attend Educational Conferences	4.0	0.0	16.0	8.0	72.0
24. Provide motivation for technology integration efforts	0.0	0.0	4.2	8.3	87.5
25. Provide one-on-one tech training to teachers	0.0	0.0	4.0	12.0	84.0
26. Provide small group tech training	0.0	0.0	0.0	0.0	100.0
27. Provide whole school/large group training.	0.0	4.0	32.0	4.0	60.0

	Not		Somewhat		Extensively
28. To what degree did your school **administration** support **your technology coaching** efforts?	0.0	3.8	7.7	0.0	88.5
29. To what degree did your school **administration** support the **overall technology integration efforts** at your school?	0.0	3.8	7.7	0.0	88.5
30. To what degree did the **number of teachers in your school** negatively impact your ability to coach, support, and provide training to **all** teachers activities to help them become aware of their strengths and needs,	30.8	23.1	26.9	7.7	11.5
31. To what degree were teachers involved in selecting the types of training or making decisions regarding the overall technology integration efforts at your school?	0.0	7.7	15.4	19.2	57.7
32. To what degree did your schedule allow the time to routinely provide follow-up assistance to teachers after they participated in technology training?	0.0	7.7	15.4	38.5	38.5
33. To what degree did you have the time and/or expertise to design or select technology training sessions that met the specific needs of teachers teaching different grade levels and/or different subject areas?	0.0	7.7	11.5	23.1	57.7
34. To what degree were you as Technology Coach, able to fulfill the responsibilities as described by the following statement: **"The Technology Coach is there in a supportive, coaching, and training mode, and therefore cannot and should not be used in the capacity of Technology Support."**	0.0	11.5	19.2	42.3	26.9

Roles and responsibilities. The next series of survey questions listed 22 different responsibilities that coaches might be asked to assume. First the coaches were asked to rate the *frequency* of their involvement. Those items on which 80% or more of the coaches responded "4" (>Somewhat) or 5 (Extensively) were: set up and load software, order hardware/software, troubleshoot classroom or lab computers, design technology training sessions (Note: Extensive), assist teachers with computer skills, coach teachers to use technology, locate web-based technology integration materials, provide motivation for technology integration efforts, provide one-on-one tech training to teachers, and provide small-group tech training. Areas in which more than 20% responded 1 (Not) or 2 (<Somewhat) were set up/maintain networks, visit other schools, and provide whole school/large-group training.

A second series of ratings asked coaches to evaluate the same roles/responsibilities with regard to the degree to which the particular task supported technology integration efforts. These ratings were generally correlated with the initial set. Items receiving the highest percentages of ratings of 4 or 5 were design technology training, order hardware/software, assist teachers with computer skills, coach teachers to use technology, locate web-based technology integration materials, attend technology training, provide one-on-one training, and provide small-group training. Items receiving the highest percentages of lower ratings were assist administration with computer skills, assist school staff with computer skills, assist parents with computer skills, and visit other schools to observe.

Support and resources. The final set of items asked respondents to rate the level of support received and degree of attainment of the defined coaching role. As shown in the summary table, there was strong consensus that extensive support was received from the administration. Less than 20% expressed concern (4 or 5 rating) that the number of teachers at the school had a negative impact on the implementation of training. About three-fourths of the coaches were positive about teachers' involvement in decision making, and a similar percentage about having a flexible schedule and sufficient time to meet teachers' needs. Close to 70% mostly or extensively agreed that they were able to fulfill the formally defined responsibility of the technology coach.

Open-ended. The open-ended responses to the survey are summarized in Table 22. Coaches viewed the technical support they received and the equipment acquisition as helpful to their success. Primary barriers were lack of time, equipment problems, and some teacher resistance.

Table 22

Open-Ended Responses on the Technology Coach Survey

Coach Selection		
Question	Responses	Frequency
How were you selected?	1. Chosen by principal, assistant principal, or administration 2. Only person interested/applied 3. Chosen by committee 4. I wrote the Grant 5. Asked by grant writers	14 5 5 4 4
Why were you selected?	1. Tech. Knowledge/ Previous held Tech position 2. Only nominated/willing	28 4
List key supporting factors to achieving Goal 1.	1. Amount and quality of training 2. Funds and Resources (i.e. computers, training stipends, fast Internet access) 3. Having a technology coach who is easily available 4. Administration/Leadership support	17 12 11 8
List key barriers to achieving Goal 1.	1. Time for training 2. Teacher resistance to change/lack confidence in tech. ability 3. Availability/Quality of tech. resources 4. Large number of teachers involved 5. Implementation lag	9 6 6 4 2
List key factors to achieving Goal 2.	1. Upgrade in quality and quantity of equipment	30
List key barriers to achieving Goal 2.	1. Large number of teachers/limited funding for resources 2. Technical difficulties 3. Late delivery of tech equipment 4. Time/Scheduling 5. Lack of teacher buy-in	11 5 4 2 1
List key factors to achieving Goal 3.	1. Internet infrastructure/connection already in place 2. Administration support 3. More/New computers	14 5 4
List key barriers to achieving Goal 3.	1. Slow server, technical problems/lack of technical support 2. No barriers 3. Late installation	12 2 2
List key factors to achieving Goal 4.	1. New software specific to education goals 2. Use of online support tools 3. Teacher input and selective purchase software 4. Training for new software 5. Teacher implementation of online tools	13 8 8 5 4
List key barriers to achieving Goal 4.	1. Availability of time and money 2. Delay in online resource connection 3. Tech. Problems/lack of tech support 4. Software does not support skill teacher want 5. Teacher buy-in/tech knowledge	10 5 4 3 2

Teacher Focus Groups

Teachers were interviewed in focus groups at each school regarding their reactions to and experiences with the TLCF program. Table 23 presents a summary of the categories of responses that we derived for each question. A summary of key findings follows.

Goal 1: Training and support. The teachers were extremely positive about the activities and attainments associated with Goal 1. They believed that they received extensive support from the coach and substantial training.

Goal 2. Multimedia computers. The teachers conveyed that most classrooms had modern computers, although a few were still lacking adequate hardware. Positive factors related to Goal 2 were receiving mobile laptop computers and increased student access to and interest in computers. Nonetheless, many teachers still believed that the quantity of computers was still not sufficient to support integration. Equipment failures (servers in particular) and slow repairs were also seen as problems.

Goal 3. Internet connection. Of the 26 schools, 23 were characterized as connected to the Internet. Benefits were viewed as e-mail communications for exchanging materials and ideas, research capabilities, and increased student interest. Concerns were expressed about equipment needs, technical difficulties, and the slow response rates of the servers.

Goal 4. Software and online resources fully integrated. This goal was viewed as partially realized through teachers' becoming much more familiar with and skilled at using Internet software and other types of applications. However, few teachers appeared to be "fully integrating" software and online resources into the curriculum during this first year of TLCF. Teachers commented positively about the training, student interest, and obtaining software. On the negative side, they felt that they needed additional training, an earlier start in the school year, and more time to incorporate their new skills and knowledge into actual lessons.

Other reactions. Teachers strongly felt that they were using and integrating technology more than in the past. As evidence, they described everyday use in many classes and fully scheduled laboratories. They further felt that the quality of teaching and learning activity had been improved, as exemplified by student-centered activities, improved student work, decreased drill-and-practice, increased emphasis on higher-level thinking, and more meaningful use of Power Point.

Teachers described events contributing to the development of a "professional learning community." Specifically identified was increased collaboration and meetings with coaches and team leaders. Impacts on school climate were seen as positive from the standpoint of increasing student ownership, faculty bonding and morale, and excitement by the school community, including parents.

Lesson design and delivery were seen as changing in several ways. Planning was more extensive and systematic. Technology was much more likely to be incorporated, due to teachers' enhanced skills and student interest. Greater attention was given to fostering student activity and

higher-order learning. Coaching and facilitating were used more as instructional strategies. "Best practices" were viewed as matching testing objectives to standards and integrating technology to support mastery of the standards. As a consequence of these activities, teachers believed that student achievement scores were improving. Other perceived outcomes were higher computer literacy and fewer discipline problems.

When asked to identify the greatest benefits of TLCF, teachers most frequently noted the training and coach support, having access to computers, improved student achievement, software acquisitions, and modernizing the school. Challenges were viewed as time, stress due to frustrations and change, and the demands of learning so many new skills. Suggested improvements were to involve the faculty and begin the training earlier in the year, extend the duration of the grant, and provide full-time technical support.

Table 23

Summary of Teacher Focus Group Responses

GOAL 1: *All teachers will have the training and support they need to help students learn using computers and the information superhighway*.

Extent Realized	Positive Factors	Negative Factors
• Fully realized, had lots of training • Had coach support • Lots of opportunities • Able to get follow up help	• Using the technology resources more • Coach was available to help • Collaborating more with other teachers • Had lots of training	• Lack of time • Finding the time for training • So much to learn • Got computers late

GOAL 2: *All teachers and students will have modern multimedia computers in their classrooms.*

Extent Realized	Positive Factors	Negative Factors
• Most classrooms had modern computers or access to • A few classrooms are still lacking • New laptops for teachers	• Having access to mobile laptop labs • Ability to take teacher laptops home • Student access increased • Student interest increased	• Not enough computers/ always need more money • Server goes down a lot • Technology repairs slow

GOAL 3: *Every classroom will be connected to the information superhighway*.

Extent Realized	Positive Factors	Negative Factors
• 23 out of 26 schools said they're connected. • Some have the connections, but not all the computers necessary	• Communicating with e-mail • Research capabilities • Student interest • Ability to get lesson plans/ ideas	• Must plan ahead • Some sites not accessible because of the filtering software • Server slow/Internet slow • Lengthy Internet searches

GOAL 4: *Effective software and online learning resources will be an integral part of every school's curriculum.*

Extent Realized	Positive Factors	Negative Factors
• Learned a lot about online resources • Coach found good software/ purchased lots of software • Got a lot of ideas at a conference • Using a lot of Power Point	• Training • Students love it (being online, playing with software) • Getting lots of software • Many teachers made class web sites	• Need more training • Got started late in the year • Need more practice time • Need more time to incorporate what we find into lesson plans

Table 23

Summary of Teacher Focus Group Responses, continued

To what degree has there been an increase in:	
How **frequently** you and other teachers integrate technology in everyday teaching and learning?	• Increased a great deal • "Now that I have the equipment, I can do so much more"
Can you provide examples?	• Certain grades use it every day • Required to incorporate it once a day • Lab always full • Internet, software, slide shows
The **quality** with which you and other teachers integrate technology in everyday teaching and learning?	• Quality has improved • More meaningful work • More student centered
Can you provide examples?	• Using Power Point in a meaningful way • Less drill and practice, more higher level thinking • Students work is better • Student involved in finding resources
The development of a **professional learning community** of technology users?	• Brought us together • Increase in cooperative teaching • Team work increased • Mentoring helped reduce the stress/ fear of technology
Can you provide examples?	• Community of learners • We help each other • Provided a comfort level • Meetings with tech coach/ team leaders
How has TLCF impacted:	
School Climate?	• Student ownership increased • Faculty bonded • Positive- morale raised • Parents/ teachers/ kids/ admin/ excited
Teaching Practices?	• Technology being used • Higher-order activities • Broadened our activities • Facilitate learning
How you plan lessons?	• Always thinking about how to integrate technology • More interactive, student centered • More options • Sharing lessons

Table 23

Summary of Teacher Focus Group Responses, continued

How you teach?	• Plan more • Facilitate • Individualized instruction more • More interactive
Technology Use by Teachers?	• Using more frequently • E-mail • The grant made us use the technology- a good thing • Higher comfort level now
Technology Use by Students?	• Use more frequently • Students excited to use computers • Increased quality of work • Motivational
Student Achievement?	• Scores going up • Better quality • Act scores and Writing Assessment up • More computer literate • Less discipline problems • Time will tell
Can you briefly describe the key features of a "best practices" in technology usage?	• Match test objectives/ standards • Integration • Incorporating all the skills • Incorporating a variety of technology
What are the greatest benefits of participating in the TLCF Initiative?	• Training/coaches help • Computers/ laptops • Student achievement • Software • Bringing our school up to date
What have been the greatest challenges of participating in the TLCF Initiative?	• Time • Stress/ overcoming anxiety • Processing/ learning so much new information • Change/ dealing with frustrations when things go wrong
What improvements would you suggest for other schools that might implement a TLCF Initiative?	• Get the faculty involved from the beginning • Start training early in the year, or before • Extend length of grant • Full time tech support

Principal Interviews

Principals were interviewed with regard to the four Goals of TCLF and reactions to the program's impact on teaching, school climate, and technology integration. A summary of the major categories of responses to each question is presented in Table 24. Overall findings are highlighted below.

Goal 1: Training and support. The principals demonstrated strong consensus that Goal 1 was realized. They believed that many teachers were impacted, interest was high, student work improved, and the coaches were effective. Negative factors were the removal of teachers from the classroom, some teacher resistance, and the time demands.

Goal 2. Multimedia computers. The principals conveyed that this goal was mostly realized through the workstations established in nearly all classrooms. Some classrooms, however, still had outdated computers. Hardware had increased and students were using technology more than in the past. Adding and upgrading technology were needed to meet the full criteria of Goal 2.

Goal 3. Internet connection. Nearly all classrooms were connected, thus achieving the main criterion for Goal 3. Teachers and students were becoming more knowledgeable about, and skilled in, using the Internet. Concerns were expressed about equipment needs, technical difficulties, some teachers lacking experience or skill, and students possibly having access to inappropriate content.

Goal 4. Software and online resources fully integrated. This goal was viewed as mostly but not yet completely realized. The primary barriers were viewed as cost, additional teacher training needs, training time, and insufficient resources.

Other reactions. Principals felt that increases in technology use were visible and substantial. They believed that teachers were integrating technology into classroom instruction much more frequently and skillfully than in the past. A foundation for developing "professional learning communities" was established at many schools through enhanced communications and collaboration. School climate was described in very positive terms, thus confirming the supportive data from the SCI (see earlier section). Corroborating the observation results (from SOM, SCU, and ER), principals clearly perceived positive changes in teaching, as indicated by increased integration of technology, greater interaction with students, higher student interest, etc.

Table 24

Summary of Principal Interview Responses

GOAL 1: *All teachers will have the training and support they need to help students learn using computers and the information superhighway.*

Extent Realized	Positive Factors	Negative Factors
• Achieved goal to high extent • Many teachers impacted • Coach was tremendous help • Understanding incorporating technology	• Equipment/Lab • Teacher interest and involvement • Technical coach • Student work and interest	• Pulling teachers out of the classroom • Time-consuming • Some teachers still resisting

GOAL 2: *All teachers and students will have modern multimedia computers in their classrooms.*

Extent Realized	Positive Factors	Negative Factors
• Almost all classrooms have workstations • Still some old computers	• Increase in hardware • Students using technology more • Teachers more comfortable	• Could use more technology • Constant upgrading • The cost – need more money • Battle for time

GOAL 3: *Every classroom will be connected to the information superhighway.*

Extent Realized	Positive Factors	Negative Factors
• Almost all classrooms are connected • Becoming an integral part	• Teachers and students more knowledgeable • Independent research • Multiple learning opportunities • Technology coach	• Technical difficulties • Some teachers new to technology • Need more money for more equipment • Concern for students accessing inappropriate information

GOAL 4: *Effective software and online learning resources will be an integral part of every school's curriculum.*

Extent Realized	Positive Factors	Negative Factors
• 90% realized • It is part of the curriculum • Acquiring necessary software	• Internet incorporated • More resources for the classroom • Software adds to teachers' instruction	• Some teachers hesitant • Cost • Training time

Table 24

Summary of Principal Interview Responses, continued

To what degree has there been an increase in:	
How **frequently** teachers in this school integrate technology in everyday teaching and learning?	• Visible in every classroom • Increased tremendously
Can you provide examples?	• Lesson plans • Power Point • Students use daily
The **quality** with which teachers in this school integrate technology in everyday teaching and learning?	• Increased immeasurably • More individualized for students • Improves as teachers become more comfortable
Can you provide examples?	• Higher level activities • Researching, analyzing, presenting, etc. • Instruction time more efficient
The development of a **professional learning community** of technology users?	
Can you provide examples?	• Communications enhanced • Collaborative effort • Teams working together • Networking
How has TLCF impacted:	
School Climate?	• Morale high • Positively • Students excited • Attitude toward learning has improved
Teaching Practices?	• Incorporating technology more
How teachers plan lessons?	• Use computer and Internet • Incorporate websites • Use online standards
How teachers teach?	• More interaction with students • Integrate technology • Exposure to more information • Updated materials

Table 24

Summary of Principal Interview Responses, continued

Technology Use by Teachers?	• On a regular basis • More comfortable with it • Given them interactive tool • More effectively
Technology Use by Students?	• Increased use • Working together • Using more than ever
Student Achievement?	• Seems to have increased • Quality of work higher • Increased student interest
Can you briefly describe the key features of a "best practices" in technology usage?	• Integrating the technology into the classroom learning • Students actively involved • Higher order thinking skills • Teachers sharing knowledge and ideas
What are the greatest benefits of participating in the TLCF Initiative?	• Technology coach • Incorporating technology • Equipment gained • Learning something new • Building stronger connections within staff and between teachers and students
What have been the greatest challenges of participating in the TLCF Initiative?	• Time management • Budget management • Not having computers until later in the school year • Introducing unfamiliar and fearful teachers to technology
What improvements would you suggest for other schools that might implement a TLCF Initiative?	• Have a coach/personnel to handle the grants • Make sure older equipment is workable and all equipment is installed early in the school year • Try to gain support from the community • Make sure teachers get training and support needed • Need more time for implementation • Have contact with a school already implementing the initiative

Technology Coach Interview

Responses to the technology coach interview were transcribed by the interviewers and then subjected to coding by the researchers to identify salient categories. Tables B.1 to B.12 provide detailed summaries of the categories identified for different questions, the frequencies of responses, and sample responses. In the sections below major findings will be briefly highlighted.

What did you do to ensure that Goal 1 ("all teachers have the training and support…") was achieved?

The most common interview responses were that the coaches directly provided the training to teachers and offered a variety of training session opportunities. Other coaches provided differentiated training based on teachers' skill levels, provided ongoing support, and made resources available.

Please describe any positive factors that helped with the achievement of Goal 1.

To support the attainment of Goal 1, many coaches provided mentoring themselves and established technology leaders to work with teachers. Others obtained (or received) support from the principal, teachers, or parents. A third influential factor was having new hardware and equipment to use.

Please describe any negative factors influencing Goal 1.

The three most common responses concerned negative teacher attitudes, insufficient time during the day or week, and other job demands on the coaches.

What did you do to ensure that Goal 2 (all teachers have modern multimedia computers in their classrooms) was achieved?

For a plurality of respondents the most direct way of achieving this goals was to actually purchase the multimedia technology needed. Many coaches purchased new laptops for teachers or purchased such peripheral equipment as hubs, servers, LCD projectors, and scanners.

Please describe any positive factors that helped with the achievement of Goal 2.

For this question, coaches basically reiterated that they purchased what they needed and obtained the necessary funds through the TCLF (or other sources). Some coaches discussed the value of the laptops for supporting Goal 2. Others referred to some type of needs assessment or decision-making process to determine where and what resources were needed.

Please describe any negative factors that impeded the achievement of Goal 2.

The most common response category concerned not having sufficient funds to obtain all the computers needed. Other barriers were the late arrival of the technology ordered, having to learn too much too quickly, and experiencing equipment breakdowns.

What did you do to ensure that Goal 3 (every classroom connected to the information superhighway) was achieved?

The majority of responses indicated that the classrooms at their schools were already connected. The only other response category with multiple frequencies concerned the coaches setting up wireless labs or hubs.

Please describe any positive factors that helped with the achievement of Goal 3.

The most commonly identified factor was having technical assistance. As indicated above, in many cases, the Internet connections were already set up.

Please describe any negative factors that impeded the achievement of Goal 3.

Three responses were most frequently given concerning barriers to attaining Goal 3: insufficient technical support, not all classrooms being ready for Internet connections, and unreliable or too-slow Internet service.

What did you do to ensure that Goal 4 (effective software and online learning resources will be an integral part of every school's curriculum) was achieved?

The most frequent activity to address Goal 4 was communicating with teachers regarding their needs and the software applications that might be used. Other strategies used by multiple respondents included purchasing software, acquiring online Internet resources, and researching available software programs.

Please describe any positive factors that helped with the achievement of Goal 4.

Multiple responses were made in reference to four positive factors: grant money, time to practice, training on the software, and freedom of software selection.

Please describe any negative factors that impeded the achievement of Goal 4.

Clearly the most frequently identified negative factor was lack of time. Other common problems concerned technical problems, negative teacher attitudes, teachers' need for help in finding resources, and the late start of integration training.

Additional Interview Responses

The coaches' responses to additional questions regarding their responsibilities are summarized in detail in Table B.13 (in Appendix B). A synopsis of major responses for each item is provided below.

Training design. Coaches were actively involved in designing technology training sessions. A key component was assessing teachers' needs and communicating with teachers.

Types of training. Varied topics were covered, including basic computer care and operations, software applications, and Internet use.

Assessment and evaluation of needs. The coaches administered surveys, visited classes, determined competency levels, and asked for teacher input.

Motivating teachers. Motivational strategies included verbal praise and encouragement, extrinsic incentives, modeling, and recognition.

Modeling technology integration. The coaches taught demonstration lessons, provided examples, and offered individual help.

Coaching. Most of the coaching was done individually. Mentor relationships were also established.

Visits to other schools. Only a few coaches had the opportunity to visit other schools to observe technology applications. When such visits were conducted, the schools were selected on the basis of recommendation, proximity, scheduled meetings at those sites, or explicitly by the grant proposal. The positive impacts of such visits were learning new techniques, seeing future possibilities, and having references for confirming present accomplishments.

Use of outside experts (exemplary teachers). Most sites did not have the opportunity to use exemplary teachers for providing workshops. In those that did, the coaches felt that the experiences worked well and increased teachers' comfort level.

Role of Technology Coach. Despite the goal of establishing the role of the technology coach as predominantly training and coaching rather than providing technology support, many interviewees saw the latter role as the more prominent. Some, however, were successful at emphasizing training over technical assistance as a result of having outside help with technical needs and principal support.

Skills and personal characteristics. Coaches identified critical skills needed for success as computer expertise, communication skills, people skills, and knowledge of teaching/technology standards. Essential personal characteristics included patience, vision, motivation, and organization.

Factors needed for school success. The coaches felt that money and time for technology training are essential. Other helpful factors are principal support and technical assistance.

Rewarding aspects. The coaches found as rewarding, being able to witness the positive changes that occurred, working with teachers one-on-one, learning new skills, and seeing students benefit.

Challenging aspects. The greatest challenges were experienced in relation to time management, overcoming teacher resistance, and motivating teachers.

Suggested improvements. The coaches felt that their effectiveness could have been increased by being trained before the school year started, having more time to collaborate with other coaches, having a longer grant period, and having more support from the district, and parents.

Administrative help. The administration provided basic support and encouragement, attended training, and permitted autonomy.

School size effects. There was general consensus that small school size facilitates implementation of TLCF.

Follow-up with teachers. To follow-up with teachers after they had completed training, the coaches indicated that they would contact them directly, visit their classrooms, and examine their projects.

Summary. Coaches conveyed a clear sense of accomplishment in achieving the four Goals of TCLF. They were active in providing and delivering training, coaching and monitoring teachers' progress, and ensuring that needed hardware, software, and Internet connectivity were obtained in all classrooms. Their major challenge was lack of time, particularly given the late start of the project. While coaches mentioned the typical problems of equipment breakdowns, some negative teacher attitudes, and lack of sufficient resources to achieve fully all goals, the overall tone of their reaction was positive, reflecting strongly that benefits to the school, teachers, and students had resulted from the infusion and attempted integration of technology in classrooms.

Technology Benchmarks

Teams from each school rated their schools' status in the Fall and Spring on each of the Technology Benchmarks developed at the inception of TLCF. The Benchmarks were organized into three Categories – Curriculum, Instruction, and Organization – and classified in one of three implementation Phases--I: Beginning; II: Intermediate; and III: Full. A summary of the percentages of Phase ratings for each Category in Fall and Spring is provided in Table 25. The results show considerably less frequent Phase I status and more frequent Phase III status for all Categories in the Spring.

Table 25

Frequencies of Ratings for Benchmarks

	Fall Phase %				Spring Phase %			
Category	*n*	1	2	3	*n*	1	2	3
Curriculum	*61*	90	6.6	3.3	*63*	3.2	27.0	69.8
Instruction	*70*	87	12.9	0.0	*73*	8.2	24.7	67.1
Organization	*166*	89	11.4	0.0	*170*	9.4	22.4	68.2

To corroborate this impression statistically, we performed a 3 (Category) x 2 (Time Period: all/Spring) mixed ANOVA on the mean ratings, with the latter factor treated as a within-subjects (repeated-measures) variable. Results showed a strong Time Period main effect, $F(1, 292) = 280.11$, $p < .001$, indicting much higher implementation status in the Spring ($M = 2.62$) than in the Fall ($M = 1.12$). Judging by the very high Spring mean and assuming that the school teams made accurate assessments, the typical Benchmark was close to being fully implemented by the end of the school year. There were no significant differences between Categories or an interaction between Category and Time Period.

Conclusions

The conclusions of the present study will be presented in association with each of the major research questions in the respective sections below.

TLCF Program Goals

To what extent are the following TLCF program goals realized?

- *All teachers will have the training and support they need to help students learn using computers and the information superhighway.*

Results from multiple sources, including reports and ratings from teachers, coaches, and principals, suggested that considerable progress was made through the TLCF activities in preparing teachers to integrate technology into curriculum and instruction. While the majority of coaches (58%) did not feel that Goal 1 was "fully" realized, nearly all (92%) rated goal attainment as either 4 or 5 on the five-point rating scale. Teachers and principals were highly complimentary in interviews about the value of the training and coaching support. Notably, on the Teacher Technology Questionnaire, statistically significant Fall-to-Spring increases (nearly all showing Effect Sizes of 0.50 or higher) in teacher ratings of their experiences and skill levels were found on all 20 items. For example, when asked if they were able to align technology to district standards, 74% of the teachers agreed in the Spring compared to only 39% in the Fall. When asked if they had been adequately trained to integrate technology, 84% agreed in the Spring compared to 39% in the Fall. Reflecting behavioral changes consistent with these impressions, results on the Survey of Computer Use showed significant increases from Fall to Spring in uses of the Internet, presentation software, and most importantly, meaningful integration of technology with classroom instruction.

Despite these impressive accomplishments, complete attainment of Goal 1 would not be realistic in only one year. Respondents noted the limited time to provide all needed training, the negative attitudes or resistance by some teachers, and the lack of opportunity to apply the skills learned to lesson design and delivery. Nonetheless, the coaching model employed by TLCF received consistent praise by all groups and clearly showed tangible positive results that appeared to exceed many participants' expectations.

- *All teachers and students will have modern multimedia computers in their classrooms.*

As indicated by the classroom observations and participant reactions, Goal 2 was close to being realized at most schools. Specifically, the SCU observations showed statistically significant increases from Fall to Spring in the number of computers that were "up to date" and had Internet access. Still, there were some classrooms observed that did not have modern or sufficient technology, a situation confirmed by teachers, principals, and coaches. Teachers who received laptops to use at school and at home were especially positive about their expanded opportunities to employ technology. Close to 80% of the coaches felt that the Goal 2 had been fully achieved at their schools. In the Spring, 80% of the teachers believed that their students had adequate access to up-to-date technology resources, a noticeable increase from the 46%

agreement in the Fall. As for Goal 1 discussed above, the progress demonstrated on Goal 2 appears considerable for a single year and thus, clearly successful by any reasonable standard.

- *Every classroom will be connected to the information superhighway.*

Multiple data sources suggest that Goal 3 (Internet) came the closest of all four goals of being fully achieved. On the basis of teacher focus group responses, 23 out of 26 schools had complete or nearly complete classroom connectivity. Principals and coaches voiced the same impression in surveys or interviews. Specifically, on the Technology Coach Survey, 85% of the 26 respondents evaluated Goal 3 as "fully attained." In 69% of the Fall SCU observations, Internet access was seen as available in "all" classrooms. This level increased to 77% in the Spring observations. Principals and coaches noted that steady progress was being made to acquire connectivity in the few classrooms still lacking Internet access. In many instances, the limiting factors had to do with wiring needs, inappropriate software, or some type of technical difficulty.

- *Effective software and online learning resources will be an integral part of every school's curriculum.*

Similar to Goal 1, progress on Goal 4 was substantial during this first year, but acquiring the resources and training for *full* goal attainment will take much more time. While coaches were positive about what was accomplished (50% actually rated Goal 3 as fully achieved), they admitted in interviews that barriers were their personal lack of time, equipment problems, some negative teacher attitudes, and the late start of the integration training. Several principals rated Goal 4 as mostly ("90 percent") achieved, but mirrored the coaches' impressions about the challenges of bringing all teachers on board and finding sufficient time for training. Teachers strongly conveyed that, despite increased skills and confidence, they still lacked the skills needed to make technology a true integral part of instruction and learning. Even where they felt prepared, due to the late start of TLCF and the many other demands on their time, they did not have sufficient opportunity this first year to take what they had learned and incorporate it into actual lessons. Still, it is noteworthy that when asked on the Teacher Technology Questionnaire whether they knew how to meaningfully integrate technology into lessons, 82% agreed in the Spring compared to only 44% in the Fall.

The observation data clearly provide empirical verification of substantial accomplishment in technology usage. SOM results showed highly significant and educationally important (*ES* = -0.83) increases in classroom uses of computers as a learning tool from Fall to Spring. On the Expanded Rubric, the strategy Students as Producers of Knowledge (technology applied to learning) was observed in significantly more targeted lessons in the Spring (90%) than in the Fall (73%). Table 11 summarizes observers' comments which reflect a much greater range and intensity of computer applications in the Spring visits. Finally, the SCU observations yielded multiple significant contrasts showing that computers were more visible and widely used in the Spring than in the Fall. It is important to note that among these contrasts were ratings of the perceived "meaningfulness" of the technology applications in achieving integration and promoting higher-level learning outcomes. These outcomes occurred in both the random (whole-school) and targeted (prearranged) visits.

Technology Integration

To what degree has there been an increase in:

- *the quality with which teachers employ technology in everyday teaching and learning?*

The most direct evidence of the quality of technology use was provided by the SCU data. In target observations, "meaningful" use of computers was seen frequently or extensively in 40% of the Spring sessions but in only 23% of the Fall sessions. On the Extended Rubric assessments, observers described many uses of technology in association with student-centered and higher-order teaching strategies. Examples included simulations, Internet searches, presentations, concept mapping, spreadsheets, and graphics applications (see Table 11). As indicated in the previous section, 84% of the teachers agreed on the Teacher Technology Questionnaire that they knew how to meaningfully integrate technology into lessons. About the same percentage agreed that their technology skills were adequate to conduct classes that have students using technology, and that technology integration has positively changed classroom instruction. Coaches and principals supported the observations and teacher self-perceptions by citing examples of effective technology use and giving positive overall impressions of teachers' progress.

Nonetheless, teachers described themselves as still in formative stages of developing skills and confidence. The lowest mean Spring rating of all the Expanded Rubric strategies was for Students as Producers of Knowledge (M = 2.21 out of 4.00), indicating low to moderate levels of quality/effectiveness in technology integration with instruction. It seems valid to conclude that teachers participating in TLCF made significant strides in teaching with technology (perhaps even more than was reasonable to expect). However, continued training and support will be needed to maintain and expand their skills while preparing new teachers to keep pace.

- *the extent with which teachers employ technology in everyday teaching and learning?*

Results from the SOM indicated occasional or more usage of computers as a learning tool in close to one-third of the Spring visits. This level is noticeably greater than the 6% rate indicated for the Fall. Similarly, computers were observed being used for instructional delivery occasionally or more in close to 40% of the Spring visits but in only 10% of the Fall visits. Targeted observations were specifically intended to view technology-supported lessons, but notably, the percentage of classes rated as demonstrating extensive use was almost twice as high in the Spring (49%) than in the Fall (27%). The pre-program (Fall) levels for whole-school observations, by the way, are comparable to norms for typical schools in the U.S.

Very compelling data are shown in Table 10 regarding Expanded Rubric results. For five of the seven strategies (cooperative learning, project-based learning, higher-level questioning, experiential learning, and independent inquiry), there were significant Fall-to-Spring increases in the percentage of times that technology use was observed during targeted sessions. Again, targeted sessions were intended to involve technology, but judging from the data, teachers were much more skilled at doing so following TCLF training and receiving coaching support. When

asked if they routinely integrated technology into instruction, 69% of the teachers agreed in the Spring compared to only 34% in the Fall. Further, 68% agreed in the Spring that their teaching was more interactive with technology, compared to 41% in the Fall. In conclusion, we again feel that while there is substantial room for growth and not all teachers are bought in at each school, the extent of technology usage in TLCF schools compared to typical U.S. schools was much greater during the year and especially so by the spring.

- *development of a "professional learning community" (of technology users)?*

Teachers, coaches, and principals all described the school community as highly supportive of the technology integration interventions. For example, on the Teacher Technology Questionnaire, 84% of the teachers in the Spring (compared to 56% in the Fall) agreed that teachers in the school are supportive of the integration efforts. On the School Climate Inventory, the mean on the Collaboration dimension was 3.77, well above the mid-point rating of 3.00. While coaches and principals indicated that some teachers displayed resistance or negative attitudes, the overall picture presented from the data indicates fairly high collegiality, group support, and spirit. We have frequently seen the opposite occur (due to new demands, changes, lack of buy-in) when schools have received grants to implement reforms.

These positive events notwithstanding, it seems fair to conclude that well-grounded "communities of practice" were not yet established at the majority of schools. Foundations for such communities were initiated, primarily through the coaching model and peer-support structure promoted by TLCF. These formal support systems will probably need to continue in subsequent years (with or without funding) for full communities of practice to become developed and sustained.

School Climate, Teaching Practices, Technology Use

What are school outcomes in school climate, teaching practices, degree and type of technology use, and student achievement. To what extent do these variables correlate with one another and with implementation success?

While originally we considered examining student achievement results relative to implementation and school variables, it was decided that results from such analyses could be misleading for a variety of reasons. First, unless the achievement scores can be adjusted for school and student variables (SES, prior achievement, ethnicity, student mobility), the outcomes for a given year may reflect the effects of extraneous factors much more than of the program (TLCF). Second, research on school reform strongly suggests that program effects need at least three to five years (more in high schools) to impact achievement. Third, because TLCF was implemented relatively late in the school year, its potential impacts on student achievement would have likely been attenuated. Fourth, the main goals of TLCF involved establishing a coaching-oriented professional development model that, if successful over time, would produce Internet connectivity, integration of technology, modern multi-media technology, and skilled and supportive teachers. Improved student achievement on state-mandated tests could be a secondary outcome (once the quality of standards-based teaching and learning is demonstrably

impacted), but it seems far more critical to first establish these essential precursory (implementation) effects of TLCF.

Nevertheless, examining achievement outcomes is still reasonable to pursue for both scientific and political reasons, again assuming that appropriate, qualified interpretations of results are made. We recommend that if the program continues, an examination be made in year 2 of the relationship between achievement gains and implementation quality.

Influencing Factors

What factors appear most instrumental in determining schools' success at achieving the four program goals and overall implementation of the program?

Based on the multiple data sources, we believe the following factors to have been the most influential in achieving program goals and successful implementation:

- Strong preparation and dedication of the coaches
- Effective organization of the TLCF project by the TDOE in terms of expectations, timelines, and especially, accountability
- Strong principal support at most schools
- The coaching model in general as a means of motivating and assisting teachers
- Substantive acquisition of up-to-date computer hardware and software
- Focus on classroom integration as opposed to technical aspects of technology
- Solid teacher support for the interventions
- Positive school climate (cooperation, involvement, environment, leadership, instruction) at most schools

Overall, we strongly feel that the TLCF program realized impressive progress in achieving its goals compared to similar large-scale programs and school reforms. We have rarely seen such striking triangulation of positive impressions by different participant groups as that obtained here. Coaches, principals, and most critically, teachers all perceived the program as highly beneficial for providing needed professional development, significantly upgrading technology resources, and positively changing classroom instruction. Despite these accomplishments, there is only so much that can be done in a given year to create strong structures and communities of practice needed to ensure sustainability. With another year or two of TLCF funding, it seems likely that most schools would have established such foundations. In the absence of formal grant renewals, we hope that many will be able to continue their coaching and integration programs via other sources of support or site-based initiatives. The Benchmarks established in the present evaluation could again be used as operational goals for technology integration and guiding frameworks for evaluating progress. Ultimately, for a program to be successful and sustaining, schools themselves must take ownership over implementing them. The one-year duration of the TLCF places schools on a much faster timetable for autonomy than is optimal. Still, if adequate ownership and interest exist at the school level, it should certainly be possible in future years for motivated teachers, coaches, and principals to maintain and improve the technology integration started under TLCF and documented in this report.

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